ELECTRICAL REVIEW

AN ILLUSTRATED WEEKLY JOURNAL OF SCIENTIFIC AND ELECTRICAL PROGRESS.

VOL. 35. No. 5. WEEKLY. NEW YORK, WEDNESDAY, AUGUST 2, 1899. $3 PER ANNUM. SINGLE COPIES, 10 CENTS.

Copyright, 1899, by ELECTRICAL REVIEW PUBLISHING COMPANY, Times Building, 41 Park Row, New York.

Entered at the Post Office, New York, as Mail Matter of the Second Class.

VIEWS, NEWS AND INTERVIEWS

An Associated Press dispatch from Kingston, Jamaica, says that the city of Georgetown, British Guiana, has recently introduced the electric light. A singular and interesting phenomenon is reported, which well nigh plunged the city into darkness on the first night of the rainy season. The arc lamps, which apparently are not fitted with wire-gauze tops, became centers of attraction to a species of small beetle, which swarm in myriads along the coast and river shores at the beginning of the Guiana rainy season, and each lamp was speedily filled to the brim. The front ranks of the insects then came in contact with the current, which set their bodies on fire. The result was that the lamps were rendered useless for illuminating purposes, and the fumes from the burning insects floated into the neighboring houses, to the great annoyance of the inmates. The incident may give a timely hint to the manufacturers of electric light plants for tropical cities.

It was rumored last week that New York city officials have prepared a plan of underground rapid transit which only awaits Mr. Croker's return before being filed with the Council and Board of Aldermen. The scheme, it is said, contemplates the erection of a four-track elevated road along the water front.

So far as possible, President Rossiter, of the Brooklyn, N. Y., Rapid Transit Company, will retain as motormen the engineers and firemen employed on the elevated railroads which are being electrically equipped. They will be taught their new duties and assigned to positions as fast as required.

A copper company received last week in New York city an interesting consignment from India in the shape of 9,999 bags, or 250 tons, of copper coins. They were imported as copper scrap and will be melted up and refined. With the price of copper standing as at present at about 18½ cents a pound for lake, they are worth more as copper than as coins. The copper coins of China, it is said, can also now be profitably imported and melted up for the copper that is in them. There was a profit in coining for the Oriental countries when copper ruled at 10 cents a pound.

An application for a charter to install a wireless telegraph system from Lake Bennett, Alaska, to the Canadian Pacific Railway in British Columbia has been made by W. A. Anderson and A. E. Porter, of Bennett.

In 1875, when Prof. Alexander Graham Bell was in Washington, he called on Prof. Joseph Henry, the veteran scientist, who was then secretary of the Smithsonian Institution. Bell explained to Henry his idea of a telephone, and later wrote to his parents in Canada as follows:

"I felt so much encouraged from his (Professor Henry's) interest, that I determined to ask his advice about the apparatus I have designed for the transmission of the human voice by telegraph. I explained the idea and said:

"What would you advise me to do, publish it and let others work it out, or attempt to solve the problem myself?

"He said he thought it was the germ of a great invention, and advised me to work it out myself instead of publishing.

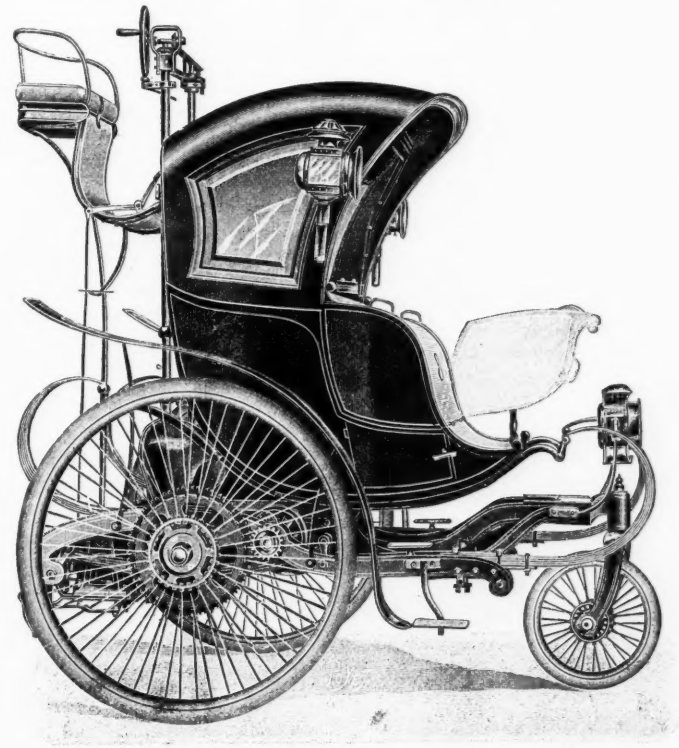


FIG. 1.—VEDOVELLI & PRIESTLEY'S ELECTROMOBILE CAB.

"I said I recognized that there were mechanical difficulties in the way that rendered the plan impracticable at the present time. I added that I felt that I had not the electrical knowledge necessary to overcome the difficulties. His laconic answer was:

"'Get it.'

"I can not tell you how much those two words encouraged me. I live too much in an atmosphere of discouragement for scientific pursuits. Such a chimerical idea as telegraphing vocal sounds would, indeed, to most minds seem scarcely feasible enough to spend time in working over. I believe, however, that it is feasible, and I have got the cue to the solution of the problem."

FRENCH TYPES OF ELECTROMOBILES.

NEW TYPES OF ELECTROMOBILES RECENTLY EXHIBITED IN PARIS.

There has just closed an exposition of automobiles under the auspices of the Automobile Club of France, at the Tuileries Garden in Paris. The number of vehicles shown was very large, and several comparatively new varieties were exhibited. The tendency to the elimination of any suggestion of the horse in the new types of vehicles is very manifest. The earlier types consisted generally of the body of a horse-drawn vehicle without the horse, but designers now seem to be paying more attention to expressing in the form of the vehicle its purpose, and have succeeded in bringing out types that are less nondescript in appearance than some of their predecessors.

It is pleasant to note that the American vehicles exhibited, notably those of the Pope Manufacturing Company (now the Columbia and Electric Vehicle Company), of the Riker Electric Motor Company and of the Cleveland Machine Screw Company, attracted much attention and received unstinted praise in the French technical journals.

One of the illustrations shows the voiturette tricycle, made by MM. Patin & Requillard. The little four-wheel carriage, which is also illustrated, is made by the same concern. It will be noticed in the voiturette type that the single wheel in front is both the driving and steering-wheel. The motor is in a sort of box contrivance above the wheel, to which it is geared through a sprocket-chain. A motor having two commutators is used. The control is had by varying the combination of the two armature windings, the two field windings and the number of cells in parallel. For the small carriages it is found that one and one half kilowatts is a sufficient provision of power. The accumulators used on these vehicles are made by the manufacturer, the cells being of the pasted variety. The little tricycle mentioned

above is probably the smallest electric vehicle that has been built. The price of such vehicles is lower in France than in this country, the tricycle selling for about $700.

Another illustration shows a tricycle-voiturette, made by M. Mildé, which is arranged to be easily changed over into a little delivery wagon. Here again the front wheel plays the double rôle of driving and steering wheel. The motor and accumulators are contained in the drum-shaped contrivance which surrounds the forward wheel. It is said that the stability of this type is very great and its control unusually easy. This tricycle weighs, without passenger, 1,300 pounds, and it is said that it has sufficient tractive adhesion to go up grades of 8 or 10 per cent even when covered with mud. The body of the vehicle can be taken off and replaced with a delivery-wagon body of small size, capable of carrying from 100 to 200 pounds of goods. The motor used has a normal power of 800 watts. A single reduction gear is used, the armature pinion working on an internal gear attached to the spokes of the forward wheel. Two small rheostats are used in connection with a series and shunt winding and grouping of the cells for control of the speed.

The extraordinary looking cab, due to MM. Vedovelli & Priestley, is chiefly remarkable for its extraordinary method of steering. This is shown in detail in the small illustration, Fig. 2. The machine is driven by the large rear wheels, the front wheel being pivoted precisely like a furniture castor. Control is obtained by letting one of the rear wheels run ahead of the other. Each wheel has a separate motor, but the two are geared together by the contrivance shown in the illustration. By turning the hand-wheel the gearing advances one of the driving wheels ahead of the other more or less, and the steering is said to be easy and simple. It would seem, however, as if there was no gain to compensate for the great complexity of the apparatus, and also as if there must be serious friction losses in so complex a mechanism.

The New York, New Haven & Hartford Railroad is equipping its system with a telephone service by which it will be possible to do away with the telegraph service if necessary. Officials of the road say that the service is intended only as an auxiliary system to the telegraph. It is claimed that the new method will effect a saving of 40 per cent.

AUTOMOBILE NEWS.

Mr. John Jacob Astor has been elected a director of the Electric Vehicle Company, of New York city.

The Equitable Auto-Truck and Power Company has purchased property at Lynn, Mass., for a factory which will afford employment to about 300 hands.

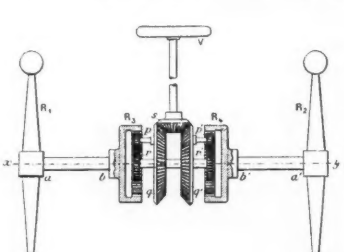


FIG. 2.—STEERING GEAR OF VEDOVELLI & PRIESTLEY'S ELECTROMOBILE.

Mr. and Mrs. William K. Vanderbilt, Jr., went to a polo game in Newport, R. I., the other day on a French petroleum automobile. The machine got stuck in the mud and its riders came home in a horse carriage.

It is said that Dr. W. Seward Webb has become interested in the Fischer Equipment Company, of Chicago, makers of the Woods motor vehicle, and that he will introduce a system of electric cabs in connection with New York Central depots in New York and other cities.

It is reported that the Riker Electric Vehicle Company has acquired the Lewis & Fowler car shops at Elizabethport, N. J., and will be able to turn out 10 automobiles daily, or about 2,500 a year of all sizes. The works are being remodelled to suit the new demands of the company.

The automobile race around France, in which great interest was taken, was finished at St. Germain, on July 24. The winner was M. De Knyff, a Belgian, who, with a 16-horse-power machine, covered the distance in 44 hours, 44 minutes, an average of 31 4.5 miles per hour. The course in many parts was hilly and sometimes mountainous, including ascents exceeding 3,000 feet.

Work on the new automobile factory of the Daimler Manufacturing Company at Steinway, L. I., is being pushed. Within 10 months it is hoped to have the factory in full operation. Interests connected with the company are said to admit that Mr. Whitney is now backing the company, and that it is proposed to increase the present capitalization of $500,000 to several times that amount.

The members of the Automobile Club, of New York, are indignant over the stand taken by President George C. Clausen, of the Park Board, who has refused to allow automobiles to enter Central Park. No order has been issued against automobiles, but no licenses have been granted to automobile owners, and they can not ride in the park without a license. They intend to test the law by riding in the park and getting arrested.

The Tractor-Truck Automobile Company has been incorporated at Trenton, N. J., to operate automobiles for the carrying of freight, passengers and express matter, the capital stock being $2,500,000, of which $1,000,000 is to be preferred stock bearing seven per cent non-cumulative dividends, and $1,500,000 common stock. The incorporators are T. Henry Dixon, J. Russell Taylor, C. Berkeley Taylor and George H. B. Martin.

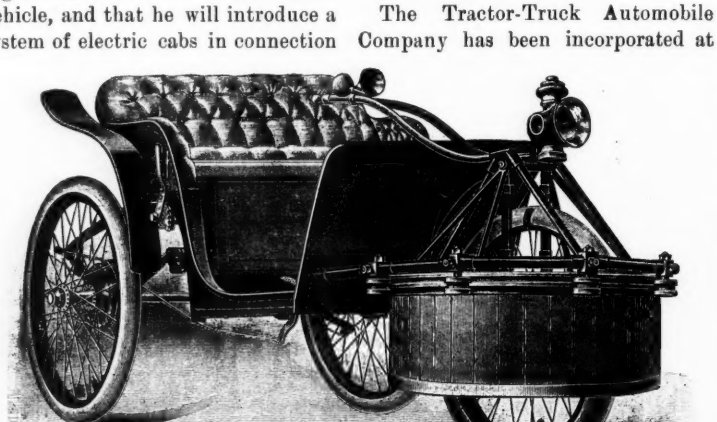


FIG. 3.—ELECTRIC "VOITURETTE" CONVERTIBLE INTO SMALL DELIVERY WAGON, MADE BY M. MILDÉ.

New Motor Cars for the New York, New Haven & Hartford Railroad.

A short description of the extension of the New York, New Haven & Hartford Railroad's electric service between Braintree and Cohasset, Mass., was given in the ELECTRICAL REVIEW for July 26, 1899. Col. N. H. Heft, chief of the electrical department of the railroad, has kindly provided the following additional data of the motor cars. He says:

"To handle this service we equipped four standard New York, New Haven & Hartford Railroad combination baggage and passenger cars, with the suitable electrical apparatus. We replaced the standard coach trucks by our standard electric trucks, built for us by the Baldwin Locomotive Works; each truck carrying, on spring suspensions, two 175-horse-power motors, of the type General Electric 55, built by the General Electric Company. Each car equipped with two such motor trucks has an aggregate rating of 700 horse-power, and handles with ease trains of several coaches met with in this service.

"The current is collected from the third rail by one cast-iron shoe hung on links directly under the king-pin of each truck, and from the overhead line at stations by trolley poles fitted with special steel-flanged bronze trolley-wheels. The speed is controlled by the regular series-parallel method, the controllers being, with the engineman's air-brake valves and other mechanism in cabs built for the motormen, inside the ends of the cars. The maximum speed made with three coaches is about 40 miles per hour."

American Electrical Apparatus For China.

The Westinghouse Electric and Manufacturing Company, of Pittsburgh, with its kindred interests, has been awarded the entire contract for the equipment of the numerous electrical plants which will be installed on the Chinese Eastern Railroad. The contract at present calls for the immediate delivery of three temporary electric lighting plants, each comprising 15-horse-power, 20-horse-power and 60-horse-power Westinghouse dynamos. The shipments about to be made are estimated to be worth some $40,000, but, as the apparatus now ordered is only for temporary work, it is assumed that $200,000 will ultimately be involved in the contract.

The Street-Railway Strike in Cleveland.

The strike of the dissatisfied employés of the Big Consolidated Street Railway, of Cleveland, Ohio, continued to develop cases of mob violence on July 24 and 25, similar to the infractions of law and order chronicled in the ELECTRICAL REVIEW last week. During the two days mentioned additional troops arrived in Cleveland from other parts of the state, until 1,500 militiamen were on duty. More cars were stoned and dynamited, and the police and soldiers were compelled to disperse groups of rioters with the club and bayonet. The Big Consolidated announced that it had between 500 and 600 motormen and conductors at work and needed no more men.

The happenings on July 26 were similar to those already mentioned, and Cleveland was practically under martial law. Every mile of street railway over which cars were running was patrolled by soldiers and police. Many cars were stoned and numerous arrests were made.

The thorough work of the state troops in preventing rioting began to be felt on July 27. A mass meeting of strikers for that night had been announced, but the crowd was compelled to move on as fast as it assembled. President Everett said he had all the men needed, and would not take back one of the strikers. A boycott against persons who traveled on the cars, and supply dealers who furnished food to the soldiers was begun on July 27 and became pronounced on the 28th. It was evident that the firemen and the police were in sympathy with the strikers. The Big Consolidated had all its lines in operation on the 27th. The State Board of Arbitration gave up its efforts to settle the strike and left the city. More cars were wrecked on July 28, but the company still had all its lines running, the strikers meanwhile endeavoring to make the boycott more effective. The cavalry was relieved from duty. On July 29 the boycott had become comprehensive, and fewer people rode on the cars than on any day of the strike. There was very little violence, and the state authorities decided that matters had reached the point where the troops could be withdrawn and the police left in charge. The troops were ordered to cease police duty, but were held in readiness for an outbreak. On July 30 a car was attacked and several policemen were stoned and repulsed by a mob. A part of a militia company restored order and got the car back to the barn. The naval militia was relieved from duty on July 31. The boycott continued effective.

Passenger Transit in Shanghai.

United States Consul-General Goodnow sends from Shanghai, June 3, 1899, a letter from which the following information is extracted: In this consular district, passenger transit on land is effected by —

1. Rickshaws and wheelbarrows propelled by men. This is the general method.

2. In Shanghai most foreigners and some Chinese have horse carriages. This is limited to Shanghai, as the outside Chinese roads are not adapted to four-wheeled vehicles.

3. From Shanghai to Woosung (14 miles) is a steam railway. The traffic is yet very light and does not require special regulations.

Transit on water is effected—

1. By steamboats.

2. By native junks (with sails), lorchas, and boats with oars.

All transit business is in the hands of private enterprise. The fare by rickshaw is 15 cents Mexican (7.2 cents United States) per hour; by wheelbarrow, about seven cents Mexican (3.4 cents United States) per hour; by donkey, 90 cents Mexican (43 cents United States) per day; by steamer, about 10 cents (4.8 cents United States) per mile, including food and lodging; by rail, about six cents (2.9 cents United States) per mile.

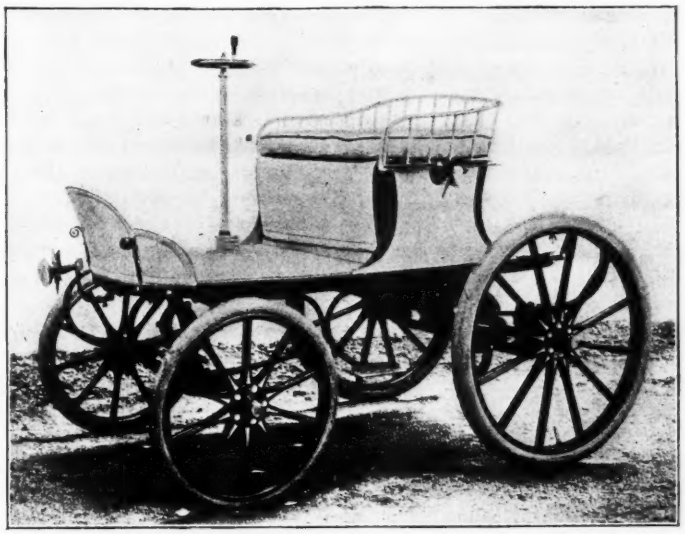


FIG. 4.—SMALL ELECTROMOBILE, MADE BY O. PATIN.

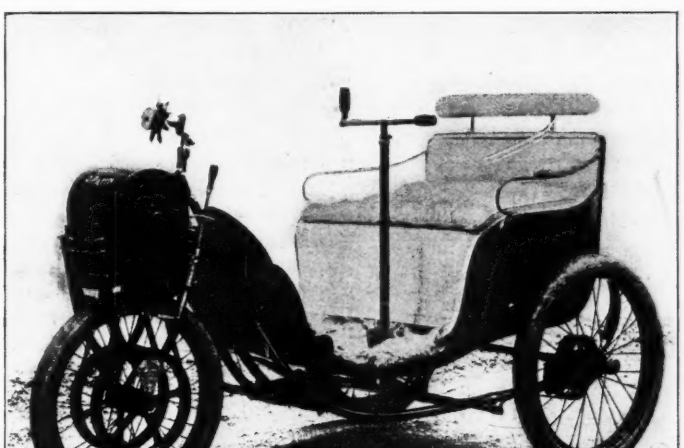


FIG. 5.—ELECTRIC "VOITUREITE-TRICYCLE," MADE BY O. PATIN.

The Western Independent Long-Distance Telephone Company, of Plattsmouth, Neb., has filed articles of incorporation with the Secretary of State; capital, $100,000; incorporators, Charles C. Parmele, Thomas E. Parmele, Thomas H. Pollock and Thomas H. Ewing. The company will build full copper metallic circuits, their object being to connect the principal cities and towns in Nebraska, Iowa and Missouri.

PERSONAL.

Mr. Rudolph Forget has been elected president of the Royal Electric Company, of Montreal, P. Q.

Prof. F. Zeeman, of Amsterdam, has been awarded the Baumgartner Prize of the Vienna Academy of Sciences.

Col. S. G. Booker, of the Phœnix Battery Manufacturing Company, of St. Louis, arrived in New York city last week.

Mr. C. E. Corrigan, general manager of the American Electric Vehicle Company, Chicago, was among the visitors to New York city last week.

Capt. H. C. Wilson, of Tallmadge & Wilson, representatives of the American Ball engine in Washington, D. C., was in New York city last week.

Mr. William B. Given, receiver of the Pennsylvania Traction Company, has been appointed a commissioner from the state of Pennsylvania to the Paris Exposition, to be held in 1900.

Attorney-General Griggs has rendered a decision to the effect that neither the War Department nor the government has power to grant franchises for railroads in Porto Rico without the authority of Congress.

There will be keen competition for the chair of Natural Philosophy at Glasgow University, rendered vacant by the retirement of Lord Kelvin. According to the *Westminster Gazette*, canvassing on behalf of candidates has already begun. The salary of the post is $5,000 a year, with a large and beautiful house adjoining the University, fitted with all modern telephonic and other electrical conveniences by its late distinguished occupant. Lord Kelvin will reside at Netherhall, Largs, his beautiful country seat.

A British Automobile Show.

A show of automobiles is to be held at Dover, between September 18 and 21 next, simultaneously with a meeting of the British Association then taking place there. The meeting at Dover will be especially noteworthy, says our London namesake, as it is held in conjunction with that of the French society taking place at Boulogne, and an interchange of visits is already arranged for. The object of the show is primarily to provide an interesting display and to benefit the motor-car industry. A small charge for space will be made, and prizes will be awarded to successful exhibitors. Full particulars may be obtained from the secretary, F. E. Beeton, Esq., Park street, Dover, Eng.

SCIENCE BREVITIES.

Transparency and Opacity—In a recent lecture which was delivered by Lord Rayleigh before the Royal Institution of Great Britain upon the above subject, a very beautiful experimental illustration was exhibited. The tints of the setting sun were illustrated by passing the light from the electric lamp through a liquid in which a precipitate of sulphur was slowly forming. The lecturer gave reasons for his opinion that the blue of the sky is not wholly, or even principally, due to particles of foreign matter. The molecules of air themselves are competent to disperse a light not greatly inferior in brightness to that which we receive from the sky.

An Intense Source of Monochromatic Light—MM. Ch. Fabry and A. Perot, in a communication to the Académie des Sciences, propose a new source of monochromatic light of great intensity. It consists of the electric arc produced between two surfaces of mercury in vacuo. The mercury is contained in two concentric glass tubes, of which the inner one divides the two surfaces of mercury. A slight shake given the tube will start the arc, which requires a potential of about 30 volts and a current of two or three amperes for stability. The light emitted is not perfectly monochromatic, but can be easily made so by the interposition of appropriate absorbing screens. A good one is a tank containing a solution of chloride of didymium and bichromate of potash. This intercepts all the rays except the green ones, and these are the most useful in most cases.

West Indian and Guiana Gutta-Percha—The constantly increasing difficulty of obtaining the great quantities of gutta required for building submarine cables has caused the various European governments to undertake the cultivation of this precious gum. M. Henri Lecomte has just published his report to the French colonial minister upon a mission on which he was sent last year to the French colonies in the West Indies and Guiana. He took with him 500 or 600 small plants, and these were distributed in Guadeloupe and Martinique, and in the botanical gardens near Cayenne. In his report, M. Lecomte bewails the fact, which will not be surprising to any one who has visited those colonies, that none of the colonial governors had taken any notice of the orders previously received by them to prepare grounds for the reception of the plants. The latest information from Guadeloupe and Martinique shows that a considerable number of the plants are in flourishing condition, but they will require careful attention for many years before they reach maturity.

The Wehnelt Interrupter—Mr. W. J. Humphreys contributes to the *Physical Review* a number of details of the Wehnelt break, some of which may be found of use, even after we have the Caldwell symmetrical form on the market. A large number of electrolytes were tested, including fused ammonium nitrate. The latter acted, though irregularly and feebly, yet sufficient to show that action is possible, even at high temperatures and in the absence of water. Roughly speaking, an electrolyte in solution acts well in proportion to its conductivity. Sulphuric, hydrochloric and nitric acids are excellent. Ammonium chloride solution gives the most rapid break of all, but the violent explosions which attend its use indicate the formation of nitrogen trichloride, one of the highest explosives known. The effect of a magnetic field is probably a new observation. If the lines of force are at right angles to the current, the minute arc which plays between the wire electrode and the liquid is blown aside. Anyhow, the action of the break is seriously hampered. When the voltage is just high enough for ordinary action, that action is stopped, or more probably reduced to the continuous stage, by a magnetic field. A higher voltage is required to restore the action, and even then it is very irregular.

Liquid Air as an Explosive "Searching experimental trials have been made at a large explosive factory in Germany as to the use of liquid air as an explosive," says *The Engineering and Mining Journal*. "The chief difficulty that had to be surmounted was that no means existed for keeping the air in a liquid state for any considerable length of time, because, when this liquid has a temperature of less than 200 degrees centigrade, every increment of heat causes a rapid evaporation, so that about half a litre of liquid air contained in an ordinary receptacle becomes completely evaporated in from 20 to 30 minutes. Now, however, means have been found to considerably prolong the continuance of air in a liquid state; and for this purpose special receptacles are used, in which the air can be kept liquid, not merely for days, but even for weeks. According to the Austrian *Chemische Technische Zeitung*, these receptacles consist of double conical glass flasks, in which a vacuum as perfect as possible is formed in the space between the inner and outer sides, while the inside of the outer glass wall is silvered with amalgam. Owing to the vacuum and also the silvering, any increment of heat is prevented from entering the inside of the flask, and the heat rays that impinge upon the outside of the flask are reflected, while the vacuum in the annular space between the inner and outer sides of the flask prevents any conduction of heat to the inside."

Electrolytic Preparation of Fluorine—In preparing fluorine by electrolysis, M. H. Moissan has hitherto used platinum vessels, says M. Fournier D'Albe in the *Electrician*. These have the disadvantage of being attacked by that most active of gases, and its production thus becomes a very costly process. He has, therefore, submitted another metal—copper—which is least subject to attack. It becomes coated with a layer of fluoride of copper, which resists further action, but at the same time disqualifies the copper from being used as an electrode. Platinum electrodes are, therefore, retained, but the electrolyte, anhydrous hydrofluoric acid rendered conducting by potassium fluoride, is placed in copper vessels. The electrodes are given the form of hollow cylinders split along their length, so as to obtain a large surface and great efficiency, and are kept insulated by stoppers of fluorspar. The vessels used are large and serve for electrolyzing some 200 cubic centimetres of hydrofluorine at a time. With 50 volts and 15 amperes there is an output of some five litres per hour, which may be increased to eight litres by using a current of 20 amperes. But the duration of an experiment must not exceed six or eight minutes, for the liquid soon heats up, and the fluorine vapor carries off with it large amounts of the acid, even if cooled to —50 degrees. Some important investigations, requiring a continuous current of fluorine gas, are now made possible.

Electricity vs. Mules in Mine-Haulage—In a paper entitled "Modern Mine-Haulage Practice," by Mr. H. K. Myers, read before a recent meeting of the Engineers' Club, of Philadelphia, are the following remarks concerning mules in mines: "About the time of the introduction of electricity into street-car service it became a question for discussion among the mining people as to its practicability for their use. In the early days the failures were numerous, due principally to the inability to fully understand the various freaks of motors, and kindred troubles. The system in general was looked on with suspicion, and considered entirely theoretic, and, with the rough usage of mine machinery, considered entirely of too dainty a nature for practical use. The dangers arising from its use were also detrimental to its installation, but this has all passed away to such an extent that bare wires are now used for feed-wires. On account of the methods for supporting these wires it often happens that they fall down and cause serious accidents to mules. In the use of 250-volt current it is found that simple contact does not kill the mule, but if he falls on it he is certainly killed.

"Of the many electric haulages installed during the past five years, very few of them have been of 500 volts, due principally to the fear of the high tension; yet the number of accidents from this voltage is no greater proportionately than for the low, and when it is considered that in the low the amount of feed-wire is greatly increased, the chance for fallen wires and danger from contact are also increased.

"The numerous accidents to mules coming in contact with these wires raised a demand for some sort of a system whereby the animal will become an unnecessary evil in the operation of a mine. To construct a bonded track and stretch a trolley wire to the face of all workings would be too expensive for general mine practice, and, in consequence, it is the custom in some mines to use a small mine wagon and have the miner push it to and fro from face to parting, from which place it is taken with the locomotive. In order to eliminate the mule from the mine and haul from the face of all workings, a combined storage and trolley locomotive has been devised, whereby the heavy work on headings is done from trolley, and while so running the attached battery, which is carried in circuit, absorbs sufficient current to do the necessary room work."

A monument to Gauss and Weber was unveiled at Göttingen on June 17, the chief address being made by Professor Voight, Weber's successor. As part of the ceremonies the honorary doctorate was conferred on Professor Moore, of Chicago; Professor Darwin, of Cambridge; Professor Hadamard, of Paris; Professor Lorenz, of Leiden; Professor Righi, of Bologno, and Professor von Sterne, of Vienna.

THE AUTOMOBILE FÊTE AND EXHIBITION IN PARIS.

DESCRIPTIONS OF THE VARIOUS VEHICLES.

The month of June was a brilliant one in Paris for electromobiles, the second annual competitive tests being followed by a fête which took place in the gardens of the Tuileries, in which all kinds of vehicles except the "hippomobile" took part. This fête inaugurated the second annual Exposition des Automobiles, which closed on July 10.

In the competitive tests, which were the second of the kind made in Paris, the different vehicles were made to run over predetermined routes, in the city or suburbs, of 60 kilometres each, which at times included steep grades and bad pavements. Their performance was noted by commissioners appointed for the purpose. The first of these annual tests was held last year, in which all of the principal types of auto and electromobiles were represented. This year the latter were in the majority. The vehicles using petroleum motors were represented by the well known types of Jeantaud and Panhard and Levassor.

Each of the vehicles was weighed, and its load determined before starting to cover the 60 kilometres. An inspector was allotted to each, who made the necessary readings of ammeters, voltmeters, etc., to determine the energy consumed throughout the course. Tests were also made as to the performance on grades and braking power, some of the electromobiles being equipped with electric brakes. These tests were very satisfactory, as the vehicles could be stopped when running down a steep grade at full speed, within a distance of five to eight metres. Among the competitors were represented the Compagnie Jeantaud, with different types of electric cabs and four-seated carriages, weighing from 1,100 to 1,450 kilos. The Cie Krieger was represented by a four-seated coupé, and among the others were a two-seated coupé of the Jenatzy make, besides several delivery wagons of different types. These latter, although much heavier than the others, made almost as good time and showed a first-rate performance in every way.

In general, the electromobiles of this year did not show any striking difference over those of last year, about the same types being preserved by the different manufacturers; however, they have been greatly improved in detail as a result of the past year's experience, and the mechanism has been perfected and better material employed. At the same time the accumulators have been equally improved, so that the final showing was much better than that of last year, and the progress made is gratifying. Most of the vehicles covered the routes of 60 kilometres in less than four hours, giving an average speed of 15 kilometres (9.3 miles) per hour, which, considering the torn-up condition of the pavements and the steep grades mounted, was a good performance. The best time was made by the Panhard & Levassor (petroleum), followed closely by the electromobile of the Krieger make. It was found that the vehicles made better time and ran more regularly than those of last year, and that the consumption of energy was less. The official report has not yet been published, but it will give some interesting figures as to the cost per kilowatt hour of the accumulators. It is probable that the expense for vehicles seating from two to four persons will not exceed 1.50 francs (30 cents) for the course of 60 kilometres; however, the wear and tear of pneumatic tires and deterioration of accumulators must be taken into account in making an estimate. The delivery wagon of the Jenatzy make weighed five tons, including two tons of freight. This vehicle requires 40 amperes at 83 volts, or four and one-half horse-power when making a speed of 15 kilometres per hour, and on steep grades this reached 150 amperes, or 16½ horse-power. An expense of 4.50 (90 cents) francs for the 60 kilometres (37.3 miles) is estimated as an average figure.

All the electromobiles of this year employed accumulators of the Fulmen type, which upon trial have been found the most satisfactory for this purpose. In one of the delivery wagons the new Blot–Fulmen accumulators were used, having positive plates of the Planté type.

These competitive tests were followed by an automobile fête, in which all the different kinds of vehicles, moto-tricycles, etc., took part. Among the interesting features were the evolutions made by M. Jenatzy in his curious electromobile, which has somewhat the form of a torpedo on wheels. The performance of this vehicle (which was illustrated and described in the ELECTRICAL REVIEW for July 19) is remarkable, a speed of 105 kilometres per hour being attained. Exhibitions of skill were also made by Messrs. Krieger, Wilfrid, Aubin and others, going at full speed forward and backward, running around obstacles, etc. These fêtes were given on the occasion of the opening of the annual Exposition des Automobiles, which was held in the gardens of the Tuileries in two immense tents which were erected for the purpose. The large number of exhibitors represented showed what importance this branch of industry holds in France. Among the principal electromobiles were the cabs of the Jeantaud Company, in which the motors are connected with the rear axle by differential gearing. The accumulators are contained partly

MR. JUSTUS C. STRAWBRIDGE WHO PRESENTED A STATUE OF BENJAMIN FRANKLIN TO THE CITY OF PHILADELPHIA.

under the seat and partly in a special case in the front of the cab. The Société Générale des Voitures exhibited a cab of the type now running in regular service in Paris, in which the accumulators are contained in a swinging box underneath the vehicle. The Krieger electromobile differs from most of the types in the fact that two motors are used, one being placed on each side between the front wheels and the body of the carriage. The wheels are driven directly by means of a pinion gearing into a large toothed wheel fixed to the front wheel of the vehicle. Each wheel thus constitutes a distinct element, thus dispensing with differential gearing and giving flexibility to the system. The "auto-cab" is distinguished as one of the novelties of this year, and may be said to be the first electromobile which presents a really elegant appearance. The driver's seat is high in the rear, and the entrance to the cab is in front. Four persons may be seated in a semi-circle facing the front; 44 cells of accumulators are used, weighing 350 kilos. The motor, of the two-pole type, is connected to the rear axle by differential gearing. The controller is arranged to give four different speeds of 4, 5, 9, 20 kilometres per hour, and to apply the electric brakes. This cab, with accumulators, four passengers and driver, weighs about 1,200 kilos (2,650 pounds).

Justus C. Strawbridge.

The ELECTRICAL REVIEW takes pleasure in presenting herewith a portrait of Mr. Justus C. Strawbridge, one of the prominent citizens of Philadelphia. He is deeply interested in the welfare and progress of Philadelphia, and his recent gift to that city of a handsome statue of Benjamin Franklin was the latest testimony of his civic pride. This statue was illustrated and described in the ELECTRICAL REVIEW for June 21, 1899. It is interesting to note that the Mayor of Philadelphia has appointed a committee of citizens to arrange for the preparation of a replica of the Franklin statue for presentation to the city of Paris. The work is to be begun as soon as possible, so that the statue can be shipped to Paris in time to be unveiled during the exposition. It will be placed at Passy, where Franklin resided when he was minister from the United States to France. Passy, then a suburb, is now in the center of the exposition grounds.

Mr. Strawbridge is a staunch supporter of the National Export Exposition, which has been mentioned frequently in these columns, and is a director of the exposition association. He is, besides, chairman of the committee on grounds and buildings, and is a member of several other important committees. Mr. Strawbridge was born near Reading, Pa., in 1838, and is a self-made man. He is prominent in city affairs, and is a director in many of the financial institutions of Philadelphia.

A New Imperial Palace at Tokio.

The chief architect to the Japanese imperial household is in this country, and will, it is reported, purchase $2,500,000 worth of materials to be used in constructing a new palace at Tokio. American electrical manufacturers should see to it that this architect has an opportunity to inspect their products, with a view to their adoption in the new palace.

The operation of trains by the third-rail system on the Fifth avenue elevated line of the Brooklyn, N. Y., Rapid Transit Company is giving satisfaction to the officials.

Electrical Review

OLDEST ELECTRICAL WEEKLY IN THE UNITED STATES.
TIMES BUILDING, 41 PARK ROW,
P. O. BOX 2330. NEW YORK.

NEW YORK, AUGUST 2, 1899.

CHARLES W. PRICE, - - - - - - - EDITOR.
STEPHEN L. COLES, - - MANAGING EDITOR.
CHARLES T. CHILD, - - TECHNICAL EDITOR.
STEPHEN H. GODDARD, ADVERTISING MANAGER.

REGISTERED CABLE ADDRESS:
"ELECTVIEW," - - - NEW YORK.

TELEPHONE CALL, 1546 "CORTLANDT."

NEW YORK OFFICE:
RUSSELL HOWLAND, GENERAL REPRESENTATIVE,
Times Building, 41 Park Row.

WESTERN OFFICE:
FRANK E. COLBERT, REPRESENTATIVE,
935 Old Colony Building, Chicago.

WASHINGTON OFFICE:
GEO. C. MAYNARD, - REPRESENTATIVE,
Room 102, Washington Loan and Trust Building,
WASHINGTON, D. C.

LONDON OFFICE:
HENRY W. HALL, - - REPRESENTATIVE,
42 Old Broad Street, . LONDON, E. C.
News, Subscriptions and Advertisements.

SPECIAL NOTICE TO ADVERTISERS.

CHANGES for advertisements must be in this office by Friday noon for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than Saturday noon to insure publication the following week, although it is occasionally possible to get in matter received on Monday.

Subscription to the ELECTRICAL REVIEW.

One Year, United States and Canada, - - $3.00
One Year, Foreign Countries, - - 5.00
Single Copies, - - - - - - - - - .10
Copies can be supplied for only one year back, at 25 cents each.

CONTENTS.

Views, News and Interviews..... 65
French Types of Electromobiles 65
Automobile News..... 66
New Motor Cars for the New York, New Haven & Hartford Railroad..... 66
American Electrical Apparatus for China..... 66
The Street-Railway Strike in Cleveland 67
Passenger Transit in Shanghai..... 67
Personal..... 67
A British Automobile Show..... 67
Science Brevities..... 68
The Automobile Fête and Exhibition in Paris... 69
Justus C. Strawbridge..... 69
A New Imperial Palace at Tokio..... 69
The Transmission of Intelligence..... 70
X-Ray Dermatitis..... 70
By Trolley from New York to Boston..... 70
Essentials of Telephone Construction..... 71
Decision in Favor of a Telephone Manufacturing Company..... 71
American Electromobile Wins a French Race.. 71
Wall Street and the Electrical Stock Market.. 71
Another Underground Electric Road in London. 71
The United States Signal Corps..... 74
American Street Railway Association..... 72
The Future of the Automobile 72
Dividends..... 72
Accumulators in a Large Apartment House.... 73
Elements of Design Favorable to Speed Regulation in Plants Driven by Water-Power..... 74
American Bell Telephone Company's Output... 75
Automobile Patents Wanted..... 76
A New Copper Company 76
A Scotch View of Electric-Railway Generators. 76
The Liquid Air Delusion in England..... 76
The Tonawanda, N. Y., Cataract Power Company 76
New York State Electrical Contractors' Association..... 76
Literary..... 76
Electric Railways in Milan..... 77
The Fundamental Law of the Increase of Gaseous Reputation..... 77
The Duncan Integrating Watt-Hour Meter..... 77
Methods of Transmitting Intelligence..... 77-8
Don't Try to Telephone This Address 79
Advance Information..... 80
The Boy, the Balk and the Battery..... 80
Kindred Interests..... xvii
Electrical Patents..... xviii
Western Trade Notes..... xviii
Trade Notes..... xviii

Advertisers' Alphabetical and Classified Index on page xiv.

THE TRANSMISSION OF INTELLIGENCE.

There has always been more or less discussion as to what was the greatest human invention. While, from some points of view, it may seem that the production of fire artificially ranks highest, its supremacy is certainly open to doubt if one thinks of the first conception of the transmission of intelligence. In another column Prof. George D. Shepardson writes at length and very interestingly of the development of methods for transmitting intelligence, either to near or remote points. The study of this fascinating subject shows that for long-distance and rapid work electrical means are solely used, and that these are highly developed; but it also makes evident the fact that the end is by no means reached.

There has been, probably, no greater silent revolution worked by any instrumentality than by the electric telegraph and its corollary, the telephone. The instantaneous dissemination of intelligence by its agency has been a mighty power for the unification of the world. The telegraph has tended to preserve peace, to increase trade, to better all sorts of political and social conditions, and to save the time of mankind. In just so far as it has saved time it has lengthened life.

The telephone has worked an ever-increasing betterment in the conditions of urban work, while its influence is rapidly extending as its use between more widely separated places increases. Like the telegraph, this electrical method for transmitting intelligence gives employment to large numbers of people, affords an opportunity for the productive application of the highest class of intelligence and has grown into a vast industry.

The ocean cable has done much of its important work indirectly. It is as true that trade goes to the end of the cable as that it follows the flag. It has long been known that civilization follows the telegraph wire in its spread, and the British Government, in building its trans-African telegraph, is doing the next best thing to completing the railway that is to follow some day approximately the same line—"from Cairo to the Cape."

In pushing westwards the limit of its territory, the United States begins acutely to feel the need of a trans-Pacific cable. While the whole east coast of Asia may now be reached by a roundabout route of telegraph lines, the dependence of business upon instantaneous facilities for transmitting intelligence has grown to such a point that the construction of a direct cable to Chinese, Japanese and Philippine points has passed being only desirable; it is necessary.

X-RAY DERMATITIS.

It is probable that the great majority of X-ray burns which are reported are due to the lack of knowledge by those manipulating the apparatus. It has come to be evident that the proper manipulation of X ray machinery requires a high and specialized degree of skill. A physician may be ever so adept along the lines of his own profession, and yet be the merest amateur in the use of the Roentgen ray. Not only is the highest order of operative skill and the widest knowledge of X-ray phenomena and application necessary to prevent injury to the patient, but also to obtain good results. It is now stated to be practically demonstrated that rays of low penetrative power produced by X-ray low-vacuum tubes and inefficient exciting apparatus are most active in causing the burns. The greatest safety, as well as the best results, will be attained by using apparatus of the highest efficiency working under the shortest exposures.

In the ELECTRICAL REVIEW for July 26, 1899, was illustrated a remarkable radiograph by Mr. E. W. Caldwell, of New York, with an exposure of one "interruption," or one flash of the induction coil through the tube. The length of the period of generation of X-rays under these circumstances has been calculated by Mr. A. A. C. Swinton to be of the order of one ten thousandth second; in the case of a coil of low inductance in the secondary it is probably considerably less than this. It is likely, therefore, that this radiograph was made in a period of time far less than any other that has been made, and it is interesting to note that, with apparatus of higher perfection, coils and tubes of greater power and interrupters of high efficiency, such results can be surely and practically attained. It would have been perfectly possible with this apparatus to make a good radiograph of a rapidly moving object.

BY TROLLEY FROM NEW YORK TO BOSTON.

In the ELECTRICAL REVIEW for July 19, 1899, was a short description of a trip made by a gentleman of this city and his family, from New York to Boston, the journey being made on electric cars. The length of the journey, exclusive of stops, was 29 hours, and of the 257 miles between the two cities, all but 52 miles were covered in electric cars. The short links between the electric systems were traversed on the ordinary steam railways. During the journey no less than 30 different electric lines were passed over. It is of interest to note that this journey, aside from being a pleasant and amusing Summer recreation, demonstrates that New England is almost covered up with electric car lines. There could probably be no better demonstration of the ubiquity of the trolley than that, without any arrangement or concerted plan on the part of the street-railway companies, they should have nearly linked together two important cities over 250 miles apart. It will be only a very short time before it will be possible to make the entire journey without going off the tracks of electric street railways. When this happy day arrives the steam railways will unquestionably begin to feel the competition of the electric lines still more acutely than they do now. The conservatism of steam railroads is notorious, and so far only one or two of the great systems of the United States have undertaken to experiment with electric traction, and then only for local service. It is probable that the history of the transformation of existing steam railways to electric lines will be very like that of the transformation of horse-car systems. When one begins, the rest will find it necessary to follow in short order.

ESSENTIALS OF TELEPHONE CONSTRUCTION.*

BY MAXIME REBER.

When an analysis is made of the numerous elements which enter into telephone construction, and the functions of each are properly weighed and considered, it becomes very difficult to separate what is essential from that which is of secondary importance. Local conditions are of such importance that methods particularly suitable in one case might be altogether unfitted for another.

A peculiarity of telephonic speech-transmission is that, under favorable circumstances, surprisingly good results can be obtained with very inferior apparatus and construction, while to secure a service that will at all times be accurate, rapid, reliable and satisfactory, requires most careful methods and the best of workmanship and materials, and no detail is too insignificant to receive thoughtful consideration.

A very important consideration before construction is started is the line capacity for which the exchange should be built. In determining what this capacity should be a careful study of the local situation should be made, and, if possible, a thorough canvass for subscribers should be made before the construction is started.

Ample provision should be made for future growth, and in making such provision estimate should be made of the ultimate capacity to which the exchange may grow. The system should then be laid out in such manner that the growth to such ultimate capacity can be made from time to time to the construction originally put in; and when the ultimate capacity is reached the exchange will be a harmonious whole. Many exchanges which have been built in the past, because proper provision for growth had not been made when the exchange was first built, have had to be completely reconstructed in the course of a few years.

The system of distribution should next receive consideration, in order to determine whether it is more economical and satisfactory to furnish all the service from one central exchange or from a central exchange with substations. This problem requires a separate solution for each city, and is one into which many elements enter. In some cases it will be found more advantageous to use the single central exchange system, while in others the central-exchange and substation system is preferable.

A complete distribution must be worked out for both systems before the problem can properly be solved, considering the cost of subways, cables (including the interconnecting trunks between substations and the central exchange), rent, light, heat, operators' pay-roll, switchboard attendants, interest on first cost, and rapidity, accuracy and reliability of service. The solution of this problem requires much time, care and accurate calculation, but it merits and should receive such attention.

As much subway should be built as the money available will permit, for when the wires are once placed in subway they require but small attention, give little future trouble, and the maintenance expense is small. They are guarded against injury from wind, sleet, fire and crosses with high-tension wires, and are free from inductive disturbances. The subway system should be built with a generous duct capacity, sufficient for the ultimate number of lines which will be supplied at the central station from which the subway starts. The subway should be laid to such grades that there will be no low points or traps in the conduit which will not drain into the manholes.

The manholes should be built of as large size as possible. Manholes are never built too large, and in no case should they be smaller in length in the direction of the subway than four feet, and should have a width of the same dimensions as the length, although width can be better sacrificed than length. The conduit should be laid in an encasement of concrete, except under particularly favorable conditions. Manholes should be built of hard-burned brick, laid in Portland cement mortar, to be plastered on the outside to make them water-tight, and as the brickwork is laid up the ironwork for cable supports should be built in, together with the laterals and ventilating pipes. Ventilation should always be provided, to prevent the accumulation of dangerous or explosive gases. Covers of manholes should be substantial castings, sufficiently heavy to carry any load that may be drawn over them. As the work progresses records of distances between manholes and the dimensions of manholes should be made, so that there may be no delay in furnishing this data to the cable manufacturer. Orders for cables should be placed as soon after subway has been constructed as possible.

Poles should be of good, sound, durable timber, and should be set vertically and so that the tops will line up in a straight line. The diameter of poles at tops and butts will vary with the kind of timber to be used, but poles of any kind should not have a smaller diameter at the top than seven inches. Heavy poles should be selected for corners and terminals, and such poles should be given a little additional depth in setting. The poles should be thoroughly guyed, and for city work poles should be set on an average not further apart than 125 feet, and should be shaved, painted and provided with pole steps. Long spans and terminal spans should be head-guyed. Poles shorter in length than 40 feet should be set to a depth of about one-sixth of their length, but long poles do not require a proportionately deep setting. In setting poles gains should be so faced that the cross-arms on alternate spans will face one another. In refilling the earth around poles, heavy tampers should be used and the ground be thoroughly compacted. In wet and treacherous ground, or at corners, where guys can not be secured, poles should be set in concrete.

Cross-arms on pole lines should be ten-pin cross-arms, preferably of long-leafed southern pine, and should not be smaller in size than three and one-fourth by four and one-fourth inches, and should receive two good coats of paint. Cross-arms should be attached to the poles by bolts passing clear through the poles, rather than to be fastened to the poles by lag screws. If wooden pins are used, they should be of locust, and should be fastened in the arm by nails driven through the shank of the pin, but steel pins are preferable.

All shims, rods, bolts, braces and other pole irons should be of good bar iron, heavily galvanized. The galvanizing should stand the usual immersion test in a saturated solution of sulphate of copper.

Pole lines should be laid out in alleys where possible, for there they are least objectionable.

(To be concluded.)

* Abstract of a paper read before the Independent Telephone Association, Chicago, June 27, 1899.

Decision in Favor of a Telephone Manufacturing Company.

Judge Bretano, of the Superior Court of Cook County, Illinois, has given a decision favorable to the Western Telephone Construction Company in the suit brought against it by Madison B. Kennedy, a former official. The decision was rendered last Saturday, and the Western Telephone Construction Company, and particularly its president, Mr. James E. Keelyn, are elated over the outcome, as the suit, which asked for a receivership, has been the cause of much annoyance and embarrassment for the last year.

In every lawsuit in which this company has engaged during the past six years, President Keelyn announces, the company has been victorious. Over 100 lawsuits have been litigated in that period. The independent telephone public generally will congratulate the Western Telephone Construction Company upon its victory in this case, particularly in view of its importance in the welfare and stability of the business.

American Electromobile Wins a French Race.

An electromobile made by the Columbia and Electric Vehicle Company, of Hartford, Ct., came in first in an automobile race in Paris on July 29. The course was from Porte Maillot to Poissy and back, a distance of about 50 kilometres. The Columbia electromobile of G. Philippart won the race in one hour, 20 minutes and 29 seconds. M. Berg, in his Columbia voiturette, made the trip in one hour, 53 minutes and three seconds, thus coming in first in the voiturette class. The Columbia electromobiles were equipped with Phenix accumulators.

Wall Street and the Electrical Stock Market.

On Monday of this week the trading on the New York Stock Exchange was the smallest of any day of the year, due largely to the belief that abnormally easy money rates would not obtain from now on throughout the Fall season. On Tuesday the market improved, reflecting a strong undertone. Reports of railway earnings have been extremely gratifying. Conservative observers find much that is encouraging in the situation. The market closed the week stronger and higher. The copper market has been very strong, and with a heavy demand for August and September deliveries, which can hardly be satisfied, as most producers are sold up for that time. No lake copper can be had for less than 18½ cents. Electrolytic is selling for 17¼ cents, while the general tendency is upwards.

On the New York Stock Exchange General Electric closed the week at 124½ bid and 125 asked, a gain of 5½ points for the week. Metropolitan Street Railway of New York closed at 212 bid and 212½ asked, indicating no change for the week. Third Avenue Railroad of New York closed at 185 bid and 190 asked, a loss of five points for the week.

On the Boston exchange American Bell Telephone closed at 347 bid and 350 asked, indicating no change for the week. Erie Telephone closed at 96 bid and 97 asked, showing no change for the week.

On the Philadelphia exchange Electric Storage Battery common closed at 152 bid and 153 asked, a loss of 7 points for the week. Union Traction closed at 42⅛ bid and 42¼ asked, a loss of ⅛ point for the week.

On the curb or outside market in New York Electric Vehicle closed at 98 bid and 100 asked, a gain of 3 points in the bid price for the week. Electric Boat closed at 14 bid and 16 asked, a loss of 1 point in the bid price for the week.

Wall Street, July 29.

Another Underground Electric Road in London.

The Metropolitan Railway, of London, announces that next October electric traction will be installed on its lines. The system is entirely underground, and the smoke and gases from the engines have always been a most objectionable feature, preventing many persons from riding on the lines. This handicap will be entirely removed by the use of electricity.

THE UNITED STATES SIGNAL CORPS.*

BY GEN. A. W. GREELEY.

The opening of the Spanish-American War found the Signal Corps with its means and methods of electrical work fully determined on and accurately formulated. It had very few officers and men, all carefully selected through promotion by merit, and a strictly limited equipment, but its officers were abreast of modern electrical inventions, and its enlisted men skilled telegraph operators, practical electricians and linemen. It needed only money and authority to develop this skeleton corps into a large organization, competent to build flying telegraph lines, to install telephone exchanges, to lay and operate submarine cables, and to construct and maintain electric light systems wherever and whenever the military exigencies required. The flying telegraph train had been brought to a high degree of excellence. With necessary instruments and batteries, the weight is yet so light that the entire plant for 100 miles can be carried in eight army wagons, to which suitable signal corps appliances can be readily attached. To insure speedy and satisfactory operation, wire, battery and lance wagons have been constructed on lines conforming best to exigencies of field service, as disclosed by past experiences. The running gear is strictly interchangeable with that of army wagons.

The standard flying telegraph train for an army corps, which is the signal corps unit, provides instruments, batteries and material for the construction of 100 miles of line. The battery power is obtained from Eagle cells, one for every mile of line. The wire used is seven-strand, composed of six steel and one copper wire, weighing about 100 pounds to the mile; for extraordinary purposes 16 miles of this wire is highly insulated. The instruments for 16 offices and eight separate lines comprise 16 sounding relays, 16 vibrators and two telephone switchboards. The special vehicles consist of two cable wagons, two battery wagons, eight lance trucks and eight wire wagons. A cable wagon carries eight miles of insulated wire, and in addition, two miles of light copper-armored cable, for crossing swamps, rivers or arms of the sea. These cables are mounted on six reels, by which they are readily distributed or recovered; in case of necessity, the reels can be removed and the distribution and recovery made by hand. Each wire wagon carries 10 miles of naked wire, and is provided with instruments and battery material, so that it may serve as a telegraph office. The battery wagons are arranged for use as a central telegraph station, having batteries, blanks and everything necessary for intercommunication, and, in addition, are fitted up as telephone exchanges. A lance truck carries 300 lances with detachable hard-rubber insulators. The lances are of tough, light wood, 18 feet long, and every fifth lance is provided with an extension butt five feet long, for use at road crossings or other important points.

Aerial lines of naked wire are usually constructed, but in emergencies, such as existed at Santiago and in the recent operations in the Philippines, the insulated wire is stretched along the road or thrown into the underbrush and thus used for days at a time. The Signal Corps has devised and approved many instruments for field telegraphy and telephony. The greatest single improvement is a device invented by Col. James Allen, Signal Corps, known technically as vibrator, type D. It is a portable kit, weighing less than 10 pounds, carried by a signal man, and is operated either with a telephone or vibrator. When inserted in a regular telegraph circuit it enables operators to send two messages simultaneously, either in the same or opposite direction, and also permits simultaneous use of the telegraph or telephone. The latest plan of the Signal Corps is to have the cable and telegraph equipages fitted with electrical power. By the introduction of electrical automobiles, the battery power is present in such form that it can be used either in connection with telegraphic operations or as a motor, according to the necessities of the occasion.

*From *Ainslee's Magazine*.

FIG. 1.—BATTERY OF ACCUMULATORS IN A LARGE APARTMENT HOUSE.

American Street Railway Association.

The next meeting of the American Street Railway Association will be held at Chicago, beginning October 17 and ending October 20. An exhibition of electric railway apparatus and appliances will be held at Tattersall's in connection with the convention. Secretary Penington has the preliminary arrangements for the meeting well in hand.

A country preacher and a young woman at St. Joseph, Mo, moved up a peg in notoriety the other day by getting married on a trolley car.

The Future of the Automobile.

There was a time when bicycles cost $150 each. Then every manufacturer whose plant was divertible to the manufacture of bicycles made bicycles. Now, after six or seven years of very active bicycle building, any one can buy a first-rate bicycle anywhere for $40, and superior buyers can probably supply themselves for about half that sum.

What automobiles cost at present is best known to persons affluent enough to purchase and play with those machines, but, reasoning by analogy, they will soon cost very much less, for every factory that can seems to be making them. Carriage factories and bicycle factories especially, all over the country, are taking orders for them. This year they are the toys of the well-to-do. By another season they will be so spread abroad that their value as playthings may have lessened; but that is of small consequence compared with the immense field that seems to be opening for them as vehicles for cheap and rapid transportation. That they will ever be brought "within the means of all" is not to be expected, but there seems to be a good prospect that they will soon be brought within the means of most persons who can afford at present to keep horses.—*Harper's Weekly.*

DIVIDENDS.

The Wisconsin Telephone Company paid dividend No. 68 of one and three-fourths per cent on July 10.

The Erie Telegraph and Telephone Company has declared regular quarterly dividend No. 63 of one per cent, payable August 14.

The Michigan Telephone Company has declared regular quarterly dividend No. 60 of one and one-fourth per cent, payable August 14.

A semi-annual dividend of two and one-half per cent has been declared by the Saratoga, N. Y., Gas, Electric Light and Power Company.

The Cincinnati, Newport & Covington Street Railway has declared a semi-annual dividend of one-half per cent, payable August 1, and the transfer books closed July 25. This is the second semi-annual dividend.

The directors of the New England Telephone Company have declared the regular quarterly dividend of $1.50 per share, payable August 15 to stock of record July 31. Transfer books closed August 1 to August 14 inclusive.

Accumulators in a Large Apartment House.

Of the many installations of chloride accumulators in New York city, one of great interest is in the apartment house at One Hundred and Seventeenth street and Lenox avenue. This house is seven stories high, and includes 22 apartments and six stores. It is typical of the modern New York apartment house, nothing having been spared in the details of construction to render it of the greatest possible comfort and convenience to the tenants.

The building is wired for 1,200 lights, and has in operation an electric passenger elevator, capable of lifting 1,500 pounds from basement to roof in 54 seconds. The lights and the elevator motor are both operated from the same generator.

In the engine-room are located the engines and generators (these are described in the letter from the engineer which appears later), and a small motor-driven booster, used to assist in charging the battery, and the switchboard. The battery panel of this board contains all instruments necessary for operating the booster and battery.

The battery, which consists of 60 cells of type "E" chloride accumulator, occupies a room by itself in another part of the basement. The cells are mounted upon wooden racks of the Electric Storage Battery Company's standard design. Each cell consists of an element of 11 plates, 7¾ inches by 7¾ inches, suspended in a glass jar having outside dimensions of 8⅝ inches wide, 9⅛ inches long, and 11¼ inches high. The capacity of the battery is 15 amperes for 12 hours, or 25 amperes for seven hours, at a pressure of 115 volts.

The battery was installed about two years after the steam plant was put into operation. During this time, therefore, the lights and the fluctuating elevator load were carried directly by the generators. A glance at the curve, showing the elevator load taken for 60 minutes, is sufficient to convince one that the generators and engines were operating at a great disadvantage. The sudden fluctuations in load were made apparent, not only by the dimming of the lights throughout the building, but by the excessive drain upon the coal pile and the repairs required upon the machinery. The battery removes these variations upon the dynamos, and, whereas they formerly ran for 20 hours each day at an extremely low efficiency, they now operate for eight hours, and always at a full and constant load.

The fact that the plant was operated in this manner for two years, and that it is now running under exactly the same conditions, but with the addition of the battery, has provided an excellent occasion to demonstrate the utility of the battery. The following letter, written by the engineer in charge, sets forth briefly the great improvement that has been effected:

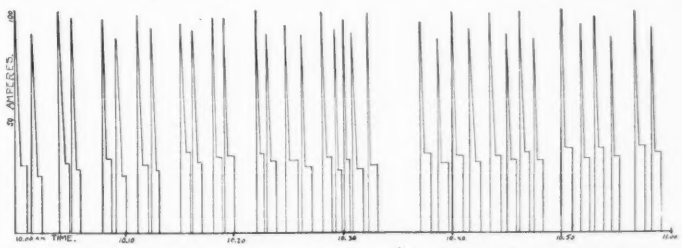


FIG. 2.—CURVE SHOWING ELEVATOR CURRENT USED IN A LARGE APARTMENT HOUSE.

THE ELECTRIC STORAGE BATTERY COMPANY,
20 Broad street, City.

GENTLEMEN: In reply to your inquiries referring to the operation of the storage battery of chloride accumulators which you installed in the apartment house at One Hundred and Seventeenth street and Lenox avenue, of which I am the engineer, I wish to state what advantages I have found since the plant was put in.

Before the battery was installed I was burning about three tons of coal per day. Now I use about one-half this.

My plant contains two generating units of 45 kilowatts, multipolar, compound, 125-volt dynamos, direct-coupled to two horizontal, high-speed, single-cylinder engines, 10 by 12 stroke, 50 horse-power; operating under steam pressure of 90 pounds, and making 300 revolutions per minute; two return-tube boilers, with grates 6 by 6½; one 2½-horse-power motor-driven booster. The building is wired on the three-wire system for about 1,200 16-candle-power lamps. We have in operation at night something over 500 incandescent lamps, and four arc lamps, six fan motors and one electric elevator motor of 12 horse-power.

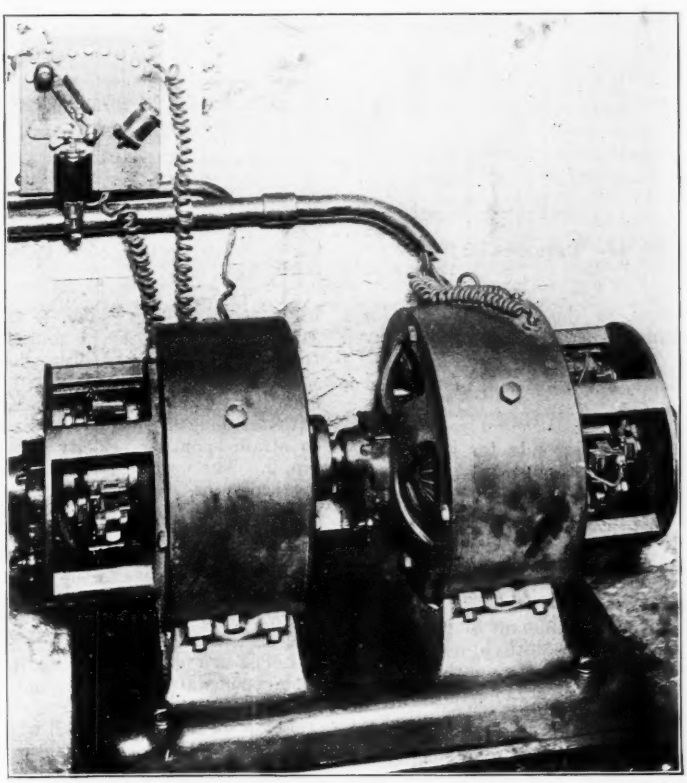


FIG. 3.—BOOSTER USED IN A LARGE APARTMENT HOUSE.

To operate all these lights and motors, I used to operate two engines, one from 7.30 A. M. and two from 7 P. M. till midnight, and one till 1.30 A. M.

I was not able to keep my engines in good order on account of the sudden load of the elevator. With the accumulators, I found that my fireman has less work, that I have more time to myself, that my engines are working better, that there is no drop on the lights when the elevator starts, that I am using less coal (that is saving one-half of what I was using before, three tons) and less oil, and that I operate the building with one engine and only use it from 5 P. M. to 1 A. M.; that is, eight hours out of 20 that I used to operate the engines.

Previously the racking and jarring on the engines as the elevator was operating was so severe that the vibrations could be felt throughout the building, but now this has been thoroughly overcome, and there is not the slightest vibration at any point.

The results of all these advantages are, a great saving in the cost of opertion, less wear and tear on the engines and dynamos, and a more efficient service.

Yours very truly,

New York, July 20.

Passing from the above interesting facts, which apply to this particular case, the following general deductions may be made covering the advantages which will apply to isolated electric plants of similar character:

(A) When the nature of the load is such that large and sudden fluctuations are produced upon the dynamos and engines, a battery is a necessity, if it is desired to operate at any but a very low efficiency. The resultant saving in fuel will soon pay for the first cost of the battery, and will be equivalent to from 10 to 40 per cent interest upon that amount, depending upon conditions.

(B) The number of hours' run required of the dynamo, which in ordinary cases without a battery is 16, 20 or even 24 hours per day, will be reduced to 8 or 10.

(C) In many cases it is customary to shut down the generators late in the evening, and to use gas or city current for the lights during the night. This item is also saved by the use of a battery.

(D) When the load on a plant becomes too great for the generators, it is not necessary to put in new boilers, engines and dynamos. The addition of a battery will bring about the desired result, and add the above advantages to the system.

(E) In case of break down in the machinery, the battery acts as a reserve, carrying the load to the full extent of its capacity during the interim.

The Electric Storage Battery Company, of Philadelphia, has installed many plants similar to the above, and will send bulletins descriptive of such installations to those interested.

It is reported that the New York, New Haven & Hartford Railroad is preparing to convert the old steam road from Berlin and Meriden to Middletown, Ct., into a third-rail electric system. Plans have been under way for months to make of Derby and Ansonia, Ct., the centers of an extensive state third-rail system.

ELEMENTS OF DESIGN FAVORABLE TO SPEED REGULATION IN PLANTS DRIVEN BY WATER-POWER.*

BY DR. ALLAN V. GARRATT.

(Continued from page 57.)

We may note a curious fact in this connection. With a water-wheel set like No. 2 in Fig. 4, working at nearly full gate, and if under these conditions a large portion of the load is instantly thrown off, and the governor is of unsuitable design and does not compensate for the kinetic energy of the slowing water column, it may be found by experiment that the speed will run higher than though there were no governor at all. This is for the reason that for an interval of time the wheel is working under light load and a greatly increased head, and there is, consequently, a greatly increased speed; or, we may say, that the amount of energy applied to the wheel under the increased pressure, even though the gate areas have been somewhat reduced by the governor, is greater than would have been the case had the gates not been moved at all.

Suppose the wheel is working at half load with the water column moving at a rate of two feet per second, and the whole load is instantly thrown on the wheel. The governor will promptly open the gate wide, but the water-wheel can not develop its whole power until the water column has attained a velocity of four feet per second. To gain this extra two feet per second the water column must have expended upon it the same amount of work which it expended in losing its two feet per second; namely, 186,330 foot-pounds, and this must be deducted from the work the wheel will do normally at full gate, so that the instantaneous value of power developed by the wheel, while the water column is gaining velocity, would equal the normal power of the wheel at full gate minus the instantaneous value of power being expended upon the water column in getting up to speed.

It is evident that the speed of the water-wheel would fall considerably below normal, and there would be absolutely no remedy for it in the present state of the art. I say this advisedly and have not forgotten the question of flywheels, which is undoubtedly in all of your minds at the present moment.

Let us now consider how long it will take the water column to get up to speed. First let us look again at wheel No. 1 for a moment. We know that the velocity of water falling without friction may be expressed by the formula:

$$V = \sqrt{2g \times H} \qquad (12)$$

where V = velocity in feet per second,
g = 32.2,
H = head in feet,

taking $2g$ outside of the square root sign, we have:

$$V = 8.025\sqrt{H} \qquad (13)$$

This is the velocity with which water should enter the water-wheel.

For purposes of simplicity I have in this paper ignored the corrections which should be made for water friction on surfaces and in orifices, as they do not alter to any large extent the stubborn facts we are considering. Such corrections are beyond the scope of this paper.

Applying formula No. 13 to wheel No. 1, and assuming that the water enters the wheel without friction, we have:

Velocity of water entering wheel under nine-foot head $= 8.025\sqrt{9} = 24$ feet per second.

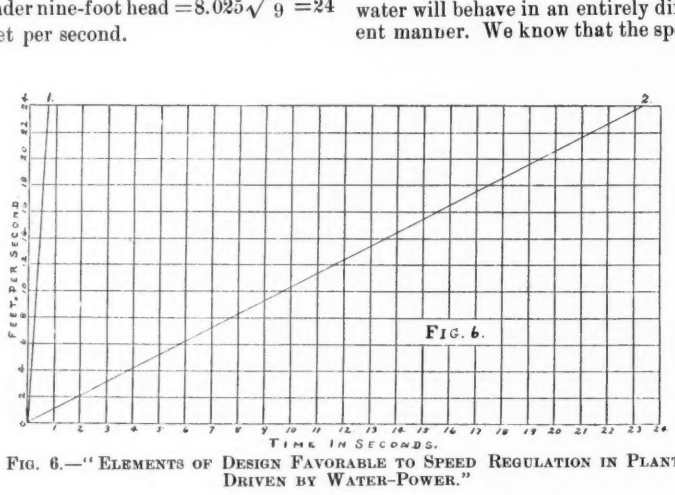


FIG. 6.

FIG. 6.—"ELEMENTS OF DESIGN FAVORABLE TO SPEED REGULATION IN PLANTS DRIVEN BY WATER-POWER."

Now, as the time required for a falling body to acquire a given velocity $= \frac{V}{g}$, we find, in the case of wheel No. 1:

Time, in seconds, for water to acquire spouting velocity into wheel under nine-foot head $= \frac{V}{g} = \frac{24}{32.2} = .7$ second.

Thus, if the gates, being closed, were instantly opened, the water would be doing its full amount of work on the wheel in seven-tenths of a second. To make the above absolutely true it would be necessary to assume that the water would enter the wheel with equal freedom at all stages of gate, which is not the case; but it is sufficiently near the truth for our present argument. We are also ignoring what is known as the velocity of approach, for reasons previously stated.

To make sure that our figures are right, let us calculate the value of V from our fundamental equation (No. 5):

$$V = \frac{F\,T}{M}$$

Assume a vertical water column of one square foot area and nine feet high. Its weight is $62.4 \times 9 = 560.7$: this $= F$.

Then

$$V = \frac{561.6 \times .7}{\frac{561.6}{32.2}} = 22.6$$

which is a close approximation to the value of $V = 24$ previously found, the slight discrepancy being due to the fact that 62.4 is not the exact weight of a cubic foot of water, and 32.2 is not the exact value of g. It might also be added that the square root of $2g = 8.025$, which is usually given in books on hydraulics, and which was previously given in formula No. 13, is a trifle too large, and a closer approximation to truth will be obtained by calling it 8.02. By using better values we can bring out $V = 23.8$.

Now, in case of wheel No. 2 the water will behave in an entirely different manner. We know that the spouting velocity at wheel No. 2 is the same as at wheel No. 1 minus the friction of the pipe. Unfortunately, we are concerned not only with the spouting velocity at wheel No. 2, but with the length of time it will take to attain spouting velocity at wheel No. 2. The water, instead of falling vertically, as in wheel No. 1, runs down an almost horizontal inclined plane. A large part of the force of gravity is applied perpendicularly to the inclined plane, and the small remainder is applied to shove the water down the inclined plane. A diagram will make this clear.

Let A in Fig. 5 = the head in feet from open water above the entrance to the flume to tail water level.

Let B = the horizontal distance in feet from entrance to flume to draft tube at tail water level.

Then C = the hydraulic slope.

Project $C_1 = A$ = the hydrostatic head.

Draw D perpendicular to C.

Complete the parallelogram.

Then the force C_1 (which we must remember is the hydrostatic head) is equal to the forces A_1 and D of which the latter is wholly sustained by the reaction of the plane C_1, while A is wholly effective in accelerating the motion of water down the slope C. We evidently wish to know the value of A_1 in terms of the triangle $A\ B\ C$ which is similar to the triangle $A_1\ B_1\ C_1$.

We know that $A_1 = C_1 \sin a_1$. Then as $C_1 = A$ and $a_1 = a$ it follows that $A_1 = A \sin a$. Let us designate the value of A_1 so found as f.

We have seen (Fig. 3) that the time to give equal masses equal velocities is inversely proportional to the forces.

Calling T the time to acquire spouting velocity down A and T_1 the time to acquire spouting velocity down C we may write

$$T : T_1 = f : A \qquad (14)$$

from which we get

$$T^1 = \frac{T\,A}{f} \qquad (15)$$

Let us apply this equation 15 to the case of wheel No. 2 in Fig. 4:

The head

$$A = 9 \text{ feet.}$$

Assume

$$B = 298.7 \text{ feet.}$$

Then

$$C = \sqrt{9^2 \times 298.7^2} = 300 \text{ feet.}$$

$$\text{Sine } a = \frac{A}{C} = \frac{9}{300} = .03$$

$$A_1 = A \sin a = 9 \times .03 = .27 = f$$

$A = 9$

$T = .7$ previously found

then

$$T_1 = \frac{T\,A}{f} = \frac{.7 \times 9}{.27} = 23.3$$

seconds required for water to acquire spouting velocity down slope C.

It may be noted that

$$T_1 = \frac{TA}{f}$$

may be written

$$T_1 = \frac{T\,A}{A \sin a} \qquad (16)$$

which by cancellation becomes

$$T_1 = \frac{T}{\sin a} \qquad (17)$$

which is its simplest form, and in which it should be used.

To make the above reasoning plainer, I have plotted (see Fig. 6) lines showing the time necessary for water to acquire spouting velocities into the two water-wheels shown in Fig. 4. Line 0-1 shows the time for water to acquire any velocity up to spouting velocity into wheel No. 1; line 0-2 shows the time for water to acquire any velocity up to spouting velocity into wheel No. 2.

It naturally occurs to one in this connection, that the water never has occasion to acquire spouting velocity in the flume of wheel No. 2; in fact, we assumed that the maximum water velocity in this flume was only four feet per second, which is only one-sixth of spouting velocity. It can be shown mathematically, and experiment proves that this does not interfere with the line of reasoning we have been following. If, instead of the end of the flume being wide open, it were five-sixths closed, the remaining sixth being an orifice (the venting areas of the water-wheel) capable of being varied at will, it would simply mean that in the flume the value of $g = 32.2$ would be con-

* A paper presented at the sixteenth general meeting of the American Institute of Electrical Engineers, Boston, June 27, 1899.

siderably reduced. This new value we should calculate and call it G. We could then substitute it for the value of g we have been using in our calculations, and the ratio of velocity and time in the open flume of wheel No. 1 and in the closed flume of wheel No. 2 would be found to be the same that we have already ascertained.

But it may be argued that we are concerned with the force which the water will apply to wheels No. 1 and No 2 while the water is getting up to spouting velocity, and not with the velocity of the water itself. Let us see at what rate the water will develop its full amount of energy on the two wheels we have been considering.

The theoretical amount of energy which flowing water can apply to an obstacle, advantageously placed in its path, may be expressed as follows:

$$P = F + F = 2\,W\frac{V}{g} = 4\,w\,a\frac{V}{2g} \quad (18)$$

where P = the theoretical energy developed,
F = the force of impulse and also reaction,
W = weight of water flowing per second,
w = weight of one cubic foot of water,
a = cross section of the stream in square feet.

It will be noted that if we assume $a = 1$, we may regard $\frac{4\,w\,a}{2g} = 3.9$ as a constant, which, multiplied by the square of the velocity of flow in feet per second, will give the theoretical force which the water will develop. I have calculated the force developed at wheels Nos. 1 and 2, as shown in Fig. 4, for each tenth of a second, beginning with the water at a rest in both cases and ending with spouting velocity, and have plotted the values in Fig. 7. Curve 0–1 shows the rate at which water standing at a rest develops its full energy on wheel No. 1. Curve 0–2 shows the rate at which water standing at a rest develops its full energy on wheel No. 2. You will note in the case of wheel No. 1 how very promptly the energy gets to its maximum value, and, in the case of wheel No. 2, how the energy lags for a considerable time before it arrives at anything like its maximum value.

I wish to emphasize this line of reasoning, because it is, perhaps, the most important thing to be considered in setting water-wheels where speed regulation is a desideratum. We can, in an imperfect way, provide for the expenditure of the energy necessary to slow up a water column, but there is no way to make a water column, while gaining velocity, do the work it is capable of when it has arrived at full velocity.

The important fact to which I want to especially call your attention is that the difficulty is measured not only by the length of the closed flume, but is inversely proportional to the sine of the angle of hydraulic slope. When the sine becomes one; that is, when the angle is 90 degrees—or, in other words, when the closed flume is vertical—then the difficulties, due to the fact that water moves slowly under the influence of gravity, have reached their minimum, and the speed regulation will be the best obtainable. As the sine of the angle of hydraulic slope grows less, then the obtainable regulation grows worse.

There is one way in which the difficulties attendant upon a small angle of hydraulic slope may be in a measure compensated for, and that is by means of a stand-pipe.

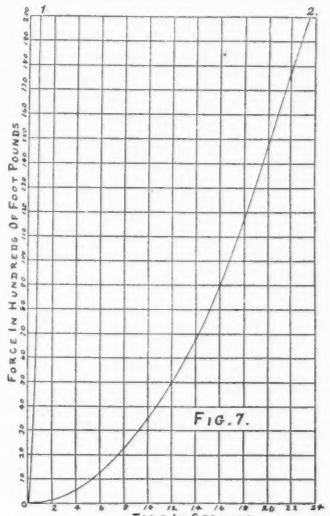


FIG. 7.—"ELEMENTS OF DESIGN FAVORABLE TO SPEED REGULATION IN PLANTS DRIVEN BY WATER-POWER."

In an electric plant, it is not usually of such importance that a load change amounting to the full capacity of the wheels be followed by a small speed variation, so that the comparatively large loads which go off and on for short intervals of time shall not disturb the speed to any great extent. Here is where the stand pipe is of value. If a portion of the load goes off instantly, and the correctly designed governor promptly closes the gates to the correct position, the excess of water will flow out over the top of the stand pipe, and the water velocity in the flume will not be arrested so promptly as though there were no stand-pipe; neither will the pressure at the wheel be much increased. To obtain these results, the stand-pipe should be only a very little higher than the water level in the pond. It should be located as near the wheels as possible, and its top should be turned over so that the escaping water can be led to some convenient point of discharge.

If, after a load has gone off instantly, it comes on again in a short interval of time, it finds the water velocity in the flume but little diminished, and also the vertical water column in the stand-pipe is ready to apply its energy to the water-wheel in the most advantageous manner. To make the last factor of much practical use, the cross section of the stand-pipe must be sufficiently large to prevent the level of the enclosed water column from falling much while the water in the closed flume is gaining its lost velocity. As a general statement, the larger the diameter of the stand-pipe, and the less its height above the hydrostatic level, the better will be the speed regulation. There has not, as yet, been sufficient practical experience with stand-pipes to formulate rules which will solve the least diameter which will result in any desired degree of speed regulation.

In the writer's experience, it has been found that the use of a stand-pipe of ample proportions will render a plant governable within very close limits under ordinary operative conditions which had proved to be utterly ungovernable before the stand-pipe was installed.

From what has been said above, it will be seen that a stand-pipe is chiefly of use in aiding a good governor to maintain a comparatively constant speed under those frequently recurring load changes which obtain in electric plants—especially in electric railway and power plants. It also gives perfect protection against dangerous water pressures being developed when circuit-breakers open, or when, for accidental reasons, it is necessary to shut down the water-wheels instantly.

A stand-pipe will not—unless of very large diameter—enable a good governor to maintain a good degree of speed regulation if the load be increased from friction load to full load instantly, where the angle of hydraulic slope is small, unless such increase of load takes place before the water in the enclosed flume has lost much of its velocity.

The writer had intended to refrain entirely from submitting designs showing the proper setting of water-wheels, for the reason that such a large number of typical plans would be required to cover all probable cases, that it would be hopeless to treat the subject properly without extending this paper beyond proper limits. He can not, however, resist the temptation to introduce at this point one design (shown in Fig. 8) which has proved to be singularly adapted to the demands of water-power-driven electric plants. It will be noted that the wheels are arranged for direct connection. The angle of hydraulic slope is practically 90 degrees, giving the best possible conditions for speed regulation. The governor may be placed directly outside the flume head and connected to the gates in the simplest possible manner. The speed variations of the main shaft may be transmitted to the governor by one belt. The requisite revolutions per minute may be obtained by varying the diameter and number of wheels. The number or size of wheels on the one shaft may vary from one to as many as can be handled by one governor, or as may be required by the capacity of the electrical unit. This general design has found favor in a number of the most prominent plants in this country as well as in Europe. The regulation is invariably good if a suitable governor be used.

It is usually the case that part of the head utilized in modern plants is below the water-wheel in the shape of a draft tube; in fact, where horizontal wheels are used it is practically necessary to have them a number of feet above tail-water level for convenience of connection to the driven machinery.

The same general rule holds good in regard to draft tubes, which, we have found, applies to closed flumes. They should be as short and as nearly vertical as possible. The maximum vertical length of a draft tube is, of course, limited by the atmospheric pressure. The water stands in the draft tube for the same reason that mercury stands in a barometer. The specific gravity of mercury is 13.6; that is, it is 13.6 times as heavy as water. Atmospheric pressure holds mercury up in the barometer tube, let us say, 30 inches or two and one-half feet; therefore it will hold water up in the draft tube $2.5 \times 13.6 = 34$ feet; that is, it would do so if the draft tube were air tight. The external atmospheric pressure at the top of such a draft tube would be 14.7 pounds per square inch. There are few draft tubes that would stand that pressure without leaking air. This fact is well recognized by hydraulic engineers, and it is rare to find draft tubes 25 feet high from tail-water level to water-wheel centers.

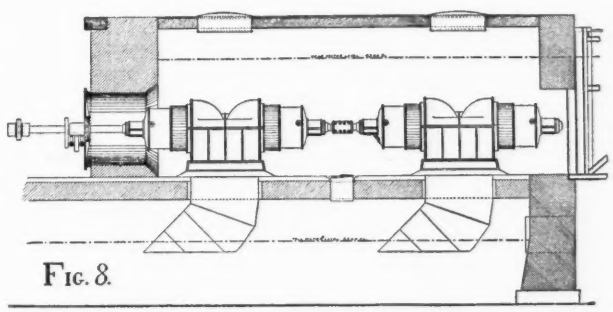


FIG. 8.—"ELEMENTS OF DESIGN FAVORABLE TO SPEED REGULATION IN PLANTS DRIVEN BY WATER-POWER."

(To be continued.)

American Bell Telephone Company's Output.

The American Bell Telephone Company's instrument statement for the month ended July 20 shows:

	1899.	1898.	1897.
Gross output.....	48,873	21,551	15,859
Returned.....	18,028	10,011	7,241
Net output.....	30,845	11,540	8,618
Since December 20:			
Gross output.....	389,809	187,884	127,778
Returned.....	109,765	83,306	51,847
Net output.....	280,134	104,578	75,931
Total outstanding..	1,405,384	1,023,699	849,780

Automobile Patents Wanted.

To the Editor of Electrical Review:

Do you know of any one who has for sale any good detail patents or system for electric, steam or hydrocarbon automobiles?

Reader.

New York, July 25.

A New Copper Company.

The Stoddard Copper Company, of Arizona, according to a financial paper, is owned by Omaha men. I. C. Stoddard, president of the mine, is in Omaha, having just returned from the mines. He says he is going East to purchase $100,000 worth of machinery. The copper mines of the company, President Stoddard says, bid fair to rival some of the great mines in richness.

A Scotch View of Electric Railway Generators.

[*From the People's Friend, Glasgow.*]

Put on your thinking cap and let us tackle the subject, determined to understand it or die!

A generator is a machine consisting of a series of copper plates all fitted on to a shaft, each being insulated; that is, separated from the others by a substance which won't conduct or carry electricity. This shaft, with the copper plates, is about three feet in diameter, and it revolves at the rate of about one-half a mile per minute inside a big casing. In this casing are fixed eight immense magnets or reservoirs for holding electricity.

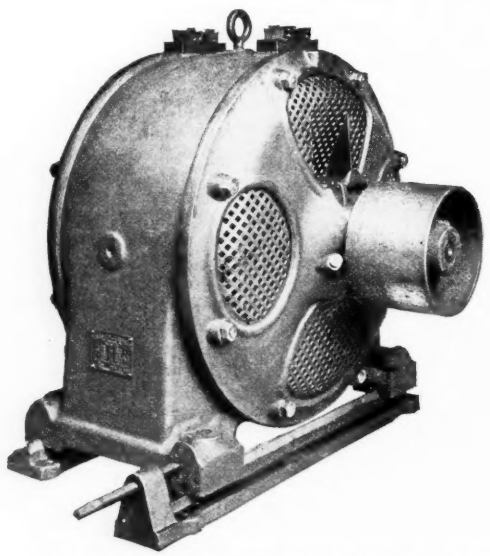
Now here comes in the most mysterious part of the whole affair. When these copper plates revolve inside of these magnets they drain away, rob, carry off the electricity, and the magnets, following their example, steal an equal quantity from the earth. The more the copper plates carry off the more do the magnets steal. [Are these steel magnets?—Eds.] The copper plates tapering out at the end of the shaft have a number of "brushes" lying against them. These brushes are also made of copper, and as fast as the copper plates become full of electricity so do these copper brushes carry it off into the electric cables.

It looks a little more simple now, doesn't it? But you mustn't think these generators are toys, for each one is constantly making enough electricity to equal the power of 300 horses. . . .

An electric motor is the simplest thing on earth—when you understand it. You know that if you hold a magnet near a piece of steel, the steel flies to it. Well, that is the principle of the electric motor, only instead of one magnet you have a number, and instead of the pieces of steel being free, they are fixed all round an axle. What is the result? One magnet attracts one piece of steel towards it, but the steel is fixed to the axle and can't move. The magnet pulls the steel towards it, however, and consequently the axle and steel move round; as soon as they are near the magnet, the axle is moved on by the force of another piece of steel and magnet, and so on.

The Tonawanda, N. Y., Cataract Power Company.

The Tonawanda Cataract Power Company has made an important addition to its plant. It will be remembered that early in the current year this company completed its buildings, which are about midway between Niagara Falls and Buffalo. An electrical equipment was installed, and the company commenced to supply power. The additions to the plant consist of three Westinghouse type "C" induction motors, of 100 horsepower each, belted to arc light machines. Electric light will be supplied to various industrial establishments, and to neighboring thoroughfares.



Westinghouse 100-Horse-Power Induction Motor Used by the Tonawanda Cataract Power Company to Drive Arc Dynamos.

The power building is placed alongside the main transmission wires from the Niagara Falls Power Company. The current enters the building on the east side, at a voltage of 11,000, three-phase, alternating. It passes through the high-tension circuit-breakers upon the upper floor, and then down to four 500-horse-power Westinghouse transformers, which reduce the voltage to 375. From the transformers the current passes through two 500-horse-power Westinghouse rotary converters, which convert it for distribution and electric car uses. Alternating and direct current are both supplied from this station.

The construction of this plant has made it possible for the Buffalo & Niagara Falls, and the Buffalo & Lockport electric roads to be operated entirely by the electric power generated at Niagara Falls. It forms a new source of supply that permits the Buffalo & Niagara Falls road to dispense with its power-house at Tonawanda. The transformers and rotary converters are placed at one end of the building; recent additions of arc dynamos, driven by the induction motors, occupy the opposite end. The illustration herewith shows one of the 100 horse-power type "C" motors. The success of this plant, although recently installed, has been so marked that the managers of the company have been induced to add at this early date an electric lighting department.

The Liquid Air Delusion in England.

[*From The Electrician, London.*]

At Taunton last week the electric lighting committee presented a report from the consulting engineers, advising certain further improvements and extensions in connection with the electric supply works, and asked the Council for sanction to obtain tenders for the plant required. The chief opposition to the adoption of the committee's recommendations was a certain Mr. Standfast, who read an extract from *Tit-Bits*, stating that "liquid air would supersede boilers and engines, and that coal, wood and water would be required no longer. Factories would be worked by liquid air, which would be drawn from a source that was inexhaustible." From this he argued there was a possibility of the new boilers and condensers not being required for the Taunton electricity works, and it was well to pause before laying out money on them. "It is a pity," he said, "that men's minds are so shallow. . . ." It is.

New York State Electrical Contractors' Association.

The New York State Electrical Contractors' Association was organized at a convention held at Rochester on July 21. Nearly 50 delegates were present, and social entertainment was provided by a local committee. The convention was held for the purpose of effecting a permanent union among the electrical contractors of the state, and uniting them for mutual business and social advantage. The next meeting will be held at Buffalo on August 29. Rudolph Schmidt, of Rochester, was elected president; David Cronin, of Syracuse, vice-president; Wells Dygert, Buffalo, secretary; J. C. Stearns, Buffalo, treasurer; M. Jervis Myers, H. J. Sackett and M. J. Aimstead, finance committee.

LITERARY.

Oddly enough, no book has ever been published which may be fairly called an adequate treatment of the business of American journalism. It is to fill this gap that Julian Ralph, "the best reporter in the world," has written for *The Saturday Evening Post*, of Philadelphia, a series of 12 papers on "The Making of a Journalist." Mr. Ralph writes from the view-point of one who has reached the top of his profession; who has labored unceasingly in the newspaper field for 25 years; who has pursued the elusive thing called "news" into every corner of the globe, and knows the business from Alpha to Omega. To young men who would make journalism their life-work Mr. Ralph says, "Don't;" but, having thus freed his conscience, he elaborates entertainingly with anecdote and reminiscence the joys, the vicissitudes and experiences of the young man who has ink in his blood. The series will begin in the *Post* of August 12.

Electric Railways in Milan.

United States Consul Jarvis writes from Milan, Italy, in reply to an inquiry, as follows:

The transit service in Milan is electrical. All the tram lines excepting three start from the Piazza del Duomo (the Cathedral square) and run either to the various railroad stations or through the gates to points beyond the city limits. The lines above excepted are one from the Central Railroad Station that runs past the Northern Railroad Station to the Porta Ticinese Station, another that encircles the city, and a third from Porta Volta to the Musocco Cemetery.

The line that encircles the city is divided into five sections, and the fare on each section is 10 centesimi (2 cents), or 50 centesimi (10 cents) for the round trip. The line that runs from the Central Railroad Station past the Northern Railroad Station to the Porta Ticinese Station is divided into two sections, and the fare on each section is 10 centesimi (2 cents); 20 centesimi (4 cents) for the whole trip. The fare on the line from Porta Volta to the Musocco Cemetery is 15 centesimi (3 cents). The fare on each of the lines starting from the Piazza del Duomo is 10 centesimi (2 cents). But for the benefit of the working and the poorer classes, the fare is 5 centesimi (1 cent) on each line from the Piazza del Duomo and on each section of the other lines before eight A. M. in the Summer and nine A. M. in the Winter.

The total development of track system owned by the commune is 66 miles. But, as some of the trams run over the same track for certain distances at various points, the actual length of track is 42. The contract which the Società Generale Edison di Elecrtricità has with the municipality of Milan for the management of the city's tramways lasts for 20 years. The commune provided at its own expense the laying down of the tracks, which were transferred to the above society on the payment of 4,500 lire ($868.50) for each kilometre (0.62137 mile, or 3,280 feet 10 inches) of single track.

The commune pays to the above society 25½ centesimi (5.1 cents) for each car per kilometre. From the total yearly receipts are deducted the amounts paid by the society to the commune and by the commune to the society, and the remainder is divided between the society and the commune in the proportion of 40 per cent to the former and 60 per cent to the latter.

The regulations permit of cars carrying more passengers than there are seats, but, to prevent overcrowding, the gates are often closed. Only one gate is opened on each car—which will seat about 18 passengers—and this is always on the opposite side of the car from the parallel track; so there is no danger of stepping off in front of an approaching tram. There were 44,559,888 passengers carried in 1898, against 39.736,091 in 1897.

The tram service in Milan is excellent; the cars are run with care and skill, and, when it is possible, at a fair rate of speed. There are very few accidents, although there is a perfect network of tracks in the Piazza del Duomo, and many of the streets through which the trams run are very narrow. The conductors are polite and obliging.

The Fundamental Law of the Increase of Gaseous Reputation.

Let T be the scientific reputation that may be established by any means whatever, on the condition that it may be of a perfectly gaseous nature. Let J be the value which the investigator places upon popular newspaper or magazine notoriety, and J_1 that which he attaches to sound reputation as gauged by good opinion of men whose good opinion is worth having. Further, let C be the amount of his egotism, not to be regarded as constant, but as rapidly increasing in an enormous ratio, approaching asymptotically to the limit of mental alienation. Then we have

$$T = \frac{J}{J_1} - C.$$

It is manifest that under the conditions named this function may assume an infinite value, as illimitable as the boundless sea, since it is composed of two factors, one a ratio which may become as large as we please by increasing the numerator and diminishing the denominator, each without limit, and the other factor C is a quantity that, by hypothesis, expands indefinitely as a necessary consequence of the operation of the law. —*English Mechanic and World of Science.*

Mayor Fritchey has signed the ordinance transferring the franchises of the Harrisburg, Pa., Electric Company to the reorganized corporation —the Harrisburg Light, Heat and Power Company. This ordinance also authorizes the transfer of the contract to light the city for the next five years from the old to the new corporation.

The Duncan Integrating Watt-Hour Meter.

The form of integrating watt-hour meter shown in the accompanying illustrations is an extreme simplification of the motor type of meters. The moving part consists of a shaft, carrying at its lower end an aluminum disk and on its upper end an armature, or closed conductor, also of aluminum, in the shape of an inverted cup. Fig. 1 shows the shaft with the disk and cup in place.

In Fig. 2 the assembled meter is shown, without its case. The series coils are mounted on a laminated iron core, forming the greater part of the magnetic circuit Inside the aluminum cup is the stationary shunt coil, of many turns and high resistance. The aluminum disk is used as a damper, running between the poles of powerful horseshoe permanent magnets as shown in Fig. 2. These magnets are put through an elaborate ageing process, rendering them very permanent. The armature and disk naturally tend to travel with a speed proportionate to the square of the energy passing in the circuit, but this magnetic retarding device holds back with a resistance proportional to the speed, thus causing the rotation to be an accurate measure of the energy passing through the meter. It is equally accurate on inductive and non-inductive circuits. A point of considerable convenience is the method of constructing the dials for these meters. They are covered with a hard white porcelain enamel, which, besides presenting a brilliant contrast with the black figures, is of such a nature that it may be dipped in benzine without harm, thus providing a most effective and simple method of cleaning.

The meters are made, in 22 sizes, by the Fort Wayne Electric Works, Fort Wayne, Ind.

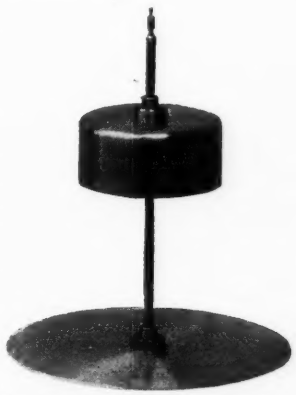


FIG. 1.—REVOLUBLE PART OF DUNCAN WATT-HOUR METER.

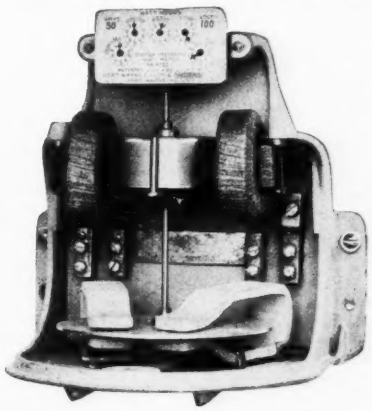


FIG. 2.—DUNCAN WATT-HOUR METER.

METHODS OF TRANSMITTING INTELLIGENCE.*

BY GEO. D. SHEPARDSON.

Transmission of intelligence is a subject of enormous importance which has attracted much attention and has called forth the best efforts of inventors, engineers and capitalists. Some idea of the enormous proportions of the service rendered by the public agencies may be gained from a perusal of a few statistics believed to be reliable.

During the year 1896, the United States mail service handled 5,693,000,000 pieces of mail at a cost of something like $90,626,000. The high-water mark of the Western Union Telegraph Company, which probably does three-fourths of the business in the United States, was reached in 1893, when it handled 66,591,858 messages for which it received $24,978,000, an average of 35 cents for every man, woman and child in the country. In 1898, the number of conversations conducted through Bell telephones was estimated at 1,231,000,000. from a test count of 3,823,070 exchange connections made in a single day. At the end of 1897, the Western Union Telegraph Company had 841,002 miles of telegraph wire in operation, enough to reach to the moon and back and go several times around the earth. At the end of 1898, the various licensees of the American Bell Telephone Company had a total of 772,989 miles of wire, while the lines of the independent companies would doubtless bring this figure up to the lines of the Western Union. Allowing a reasonable amount for the lines of other telegraph companies, would make a total of about 2,000,000 miles of wires in the United States alone for purposes of communicating by electrical methods. In the city of Chicago alone about 220,000 connections are made daily, which, with an average of three and one-half miles of wire per connection, would make about 770,000 miles of wire connected daily in one city for telephonic purposes alone.

Such figures, taken in connection with the frequent reports of telegraphing through space, suggest an interesting study into the methods of communication which have preceded the electrical methods of the present day. The writer, therefore, ventures to present an outline of some work along this line.

The terms telegraphing (writing

*The Year Book of the Society of Engineers, University of Minnesota.

afar off) and telephoning (sounding afar off) suggest that distance might be a suitable basis for classifying methods of communication. We might therefore think of the plesiophone and plesiograph as being generic terms applying to instruments or methods for communication between persons not far apart, but the difficulty of drawing a definite line between near and far distances renders such a basis unsatisfactory.

A classification into mediate and immediate methods is likewise unsatisfactory as an ultimate basis of division, since the only methods that might be called immediate (without the aid of external or sensible means of carrying thought from one mind to another) would be telepathy and perhaps methods of communicating sentiments by direct contact without the aid of words, very effective methods in special circumstances. Even these methods might be considered as being mediate, for in telepathy the ether is probably the vehicle by which the thoughts are transferred, and the other is impossible without using portions of the corporeal being.

A more promising basis of classification is upon the character of the means of communication, whether or not any record is left; that is, whether it is transient or permanent. This basis is not entirely satisfactory, since some processes of communication may or may not leave a permanent record, and the record may have all degrees of permanency from a few seconds to many centuries.

The most satisfactory basis seems to be upon the faculty by which the communication is received. All methods of communication of ideas may be divided into sensible and supersensible; the former including those that may be received by one or more of the five senses; the latter including those that seem to reach the mind directly by such means as clairvoyance, hypnotism, telepathy, and the like, methods with which the ordinary mortal may not meddle with entire impunity, but whose phenomena are discussed in the encyclopedias. These methods appeal to the curious and mystical, but are so mixed with fraud and superstition that it is difficult to distinguish fact from error. It is interesting to recall the yarns that circulated in earlier centuries, such as the "sympathetic telegraph," for which two persons had portions of skin mutually transplanted, letters of the alphabet being tatooed upon corresponding portions; when one wished to communicate with his friend, he would prick with a magnetic needle the letter or letters desired and the skin of his friend would instantly itch under the corresponding letter, no matter how far apart they might be.

Passing the supersensible methods as being beyond the scope of the present study, the most satisfactory basis upon which to classify the sensible methods of communication is the various senses by which ideas may be received. Some will affect two or more senses at once, so that even this basis is not perfect.

We may dismiss the sense of taste as a means of communication, since no such use appears except perhaps as an intermediate agency, the way to a man's heart being reputed to be through his stomach.

The sense of smell is used by the lower animals more extensively than by man. The Indians are said to be able to follow a person's trail being guided largely by scent. Stephen Powers testifies from personal knowledge that the Miwok Indians in California sometimes hang the carcasses of the unmentionable Mephitis Mephitica on trees along trails difficult to follow, so that they may be guided by one sense, if not by another. Less unsavory is the means by which we frequently learn what Inga is cooking for dinner.

The sense of touch is used most extensively by blind persons, who are able to read through their finger ends. Much information or sentiment is sometimes conveyed by the grasp of the hand. If the sense of touch or feeling be considered to include more than external contact, we might here include a method said to be resorted to by telegraphers in emergency, when they put themselves into the circuit of a telegraph line, and by means of the shocks detect the passing signals. It is conceivable, that when the current is too feeble to affect the ordinary sense of feeling, it might be tasted by the electrolytic effects when the terminals are applied to the tongue. Possibly the sense of touch is effective when deaf persons are enabled to "hear" through a stick or sounding-board applied to the teeth or forehead. Much of the so-called mind-reading is doubtless muscle-reading.

By far the most important methods of communicating ideas are those involving sight and sound. Each class may be divided according to whether suitable for conveying words, or simply signals, although the distinction can not be sharply drawn. Probably in the earliest times men had nothing that could be called words, but expressed their elementary ideas by grunts and sounds which gradually became differentiated into words. In the present stage of civilization, any methods by which sounds or visible signs may be transmitted is capable of use for sending signals which may indicate words or letters. We may, however, make a general division into those methods that can transmit words as such, and those that can only transmit symbols or signals.

The simplest method of communication by sound is when the voice of the speaker or sender reaches the ear of the recipient through the medium of the air only. By confining the sound waves to one direction or to a limited area, the distance over which the voice can be carried increases. The speaking-tube would seem to be the acme in this direction, for it confines the sound to a single direction, but its range is limited by cost and lack of portability It is said that words spoken in a low tone can be heard at a distance of three-quarters of a mile through a water pipe. Man must have learned at an early date that his voice could be heard further if his hands were held near the mouth as a sort of funnel. From this idea Kircher (1601–1680) developed the speaking trumpet, which is much used at sea and by firemen. Vitruvius (Cir. 80 A. D.) states that in the theaters of the ancients, resonant brass vessels were placed so as to strengthen the voices of the actors. Alexander the Great is said to have used a funnel through which he gave orders to his troops sometimes eight miles distant. It seems a natural step to reverse the above process and hold the hand behind the ear to reinforce the sound, which plan developed into the ear trumpet. Perhaps the height of sensitiveness and of distance covered by the combination of ear and speaking trumpet was reached by Edison, whose megaphone has enabled persons to converse in an ordinary tone of voice when several miles apart. Edison's aerophone is arranged so that the voice causes a diaphragm to vibrate and operate minute valves, which govern the flow of steam through a sort of whistle, by which the sound of the voice is said to be magnified 200 times. This easily led up to the phonograph, by which Edison was able to make a record of words or other sounds, and to reproduce them at will. The idea of recording and reproducing the human voice may have come from the yarn related by Antiphanes about a city where the cold was so intense that words were congealed as soon as spoken, and were not heard until they thawed out the following Summer. The first successful attempt to record words was by the phonautograph of Leon Scott, in 1857, described by Ganot. Twenty years later, Chas. Cros deposited with the French Academy a description of an apparatus for recording and reproducing sounds, which promised to be successful, although it does not appear that he actually constructed it. Edison worked on a somewhat similar plan later, before the paper of Cros was published, in September of the same year, making a record of indenting tin foil. Bell and Tainter improved upon it by having a minute knife cut more or less deeply into wax, a plan that was also used by Edison. Berliner was an early worker in this field and brought out the gramophone in which the record was made on a disk instead of on a cylinder as used by Edison and others.

The acoustic methods mentioned to this point have been suitable for short distances only, excepting the phonograph, whose records may be sent to any distance and there reproduced. To carry messages further, the system of messengers or couriers was developed centuries ago by Cyrus the Great in 559 B C These couriers probably carried written messages. A much earlier use was that noted by Job (perhaps 2,000 B. C.), who lamented that his days were swifter than a post, and who had learned of his misfortunes through messengers. Oral tradition should be mentioned as one means of carrying ideas over long distances and long periods of time, a method which some thinkers believe to be more accurate than written records.

The term telephone seems to have been used by Wheatstone in 1840, in connection with what are now called acoustic, mechanical or lovers' telephones, instruments consisting of a freely suspended wire or tight cord, each end of which terminates at a diaphragm. Sounds near one diaphragm cause it to vibrate and in turn to set up vibrations which are carried along the wire or cord to the second diaphragm, whose vibrations cause sound waves in the air, reproducing the words originally spoken. This device is sometimes operative over distances of a half mile or more.

The electric telephone has been decided by the courts to be the invention of A. G. Bell, although the idea was suggested by Bourseul in 1854, and a true telephone was accidentally used by Cushman at Racine, Wis., even earlier, in 1851. The work of Ries, Berliner, Gray, Dolbear, Drawbaugh and others may be found in the files of almost any electrical journal. Whatever may be said or believed about the first inventor of the telephone, to A. G. Bell and his associates must be given the credit of having reduced it to a practicable form, and of developing it to so great a degree of perfection that it is now possible to talk over a distance of 2,000 miles.

Considering next those methods that are suitable for sending signals, but not words, except as some code of signals is used to represent words, it is probable that man early learned to call the attention of those beyond the reach of his voice by whistling. Shells and other crude forms of trumpet soon served to increase his range. Instruments of percussion are in common use for attracting attention, as witness the rapping of a pencil on the librarian's desk for quiet, or pounding steam-pipes by flat dwellers for steam or quiet. Musical instruments of various sorts may be considered as means of communication, ordinarily of sentiment but sometimes of messages. The bell, used for many centuries for calling people together, seems to have been invented in its modern form in 400 A. D., although small bells were used in the days of Moses and small ones have been found in the ruins of Ninevah. The electric bell seems to have been invented in 1850 by John Mirand, thus following the telegraph by several years. The steam whistle has been developed until some of the fog-sirens can be heard from 20 to 30 miles.

That water is an excellent conductor of sound is known to every small boy who has "cracked stones" under water to the discomfort of other bathers within many rods. This property has been used in connection with funnels and bells for communication between ships separated not more than one half mile.

The electric telegraph is older than the telephone. In its early forms the signals were received by sight entire-

ly, Morse in 1832 beginning the development of a system in which the signals were recorded. Not until after the recording instruments had been in use for several years did it develop that the signals could be received by sound as well as by reading the printed or embossed record. The early history of reading by sound is a matter of controversy, a patent application of Morse in 1837, specifying that "signs or sounds or both" could be used. Otis E. Wood and other operators had learned to receive by sound as early as 1846, but it was not until 1850 that it was adopted by the company. The telegraph has been improved by many inventors, until its history is a large subject. In 1837 Steinheil found that the earth could be used for the return, and nearly all the telegraph lines in the world use the single-wire system. Morse discovered the relay principle in 1837, although this is claimed for Wheatstone, thus rendering possible the working of long lines. The problem of increasing the capacity of the telegraph lines was attacked by many persons and by various plans. Among those who devised means by which the line could be connected with a number of sending and receiving instruments, in succession, were Farmer in 1852, Meyer in 1873, Delany in 1885 and Patten in 1889. Others have worked along the line known as harmonic telegraphy, which is based upon the fact that a reed will respond only to one definite pitch. This seems to have been developed first by Gray in 1874, also by Bell and by La Cour in the same year, the latest plan being proposed by Rowland in 1899. A quite different course of development was that of transmitting simultaneously from both ends of the line, one message going in either direction. This was started in 1853 by Gintl, who was followed by Frischen, Siemens & Halske, Stark, Preece, Edison and a number of others. The success of Frischen in 1854 suggested the possibility of sending two messages in the same direction over one wire. This was attempted by Stark in 1855, whose work was followed by Kramer, Bosscha, Maron, Edison and others. These methods were not successful until 1871, when Stearns, of Boston, devised a means of obviating trouble from the static charges on the line by using an adjustable condenser at each terminal.

The success of the duplex (sending two messages at the same time in the same direction) and of the duplex (sending two messages simultaneously in opposite directions) suggested the possibility of combining the two and so sending four messages simultaneously on one wire, and the quadruplex was soon the cynosure of much activity. This was accomplished by Edison in 1874, improved upon by Garritt Smith in 1875, later by Prescott, Maver and Davis. Various experimenters have undertaken to increase the speed of the simple Morse system by preparing the messages on paper ribbons, which could be passed through an automatic sender at a high rate of speed and be received by some mechanical or chemical device with equal rapidity. The original plan of Morse was to do this, the message signals being registered by embossing a paper ribbon with a steel point, or by printing with an ink roller or pen, or by chemical action of current passing through the paper. Later workers attempted to use the heating effect of the current to burn the record on the ribbon of paper. The latter plan seems not feasible for fast work, because of the time necessary for the wire to respond to the varying heats. The chemical method has been used extensively, as well as the inking register. Bain, Morse, Davis, Edison and others have worked along this line, the details of the most successful system in use being worked out by Wheatstone. Recently it has been proposed to use photography and polarized light, by which method a speed of 3,000 to 4,000 words per minute is claimed.

Many plans have been tried with some success for sending messages without conducting wires. These methods depend upon conduction, induction or radiation. Messages were sent without wires over a distance of one mile as early as 1842, and have been sent frequently since. The laws governing such telegraphy have been recently investigated with some care by the German government telegraph department. A more common occurrence is to use induction, which may be either electromagnetic or electro-static. The former was used in the method of Phelps for telegraphing to and from railway trains, and is frequently a cause of "cross-talk" on telephone lines. Cross talk is, however, more commonly caused by electrostatic induction as shown by Carty in 1889. By such induction, Dolbear succeeded in 1886 in telephoning a distance of a half-mile. In 1879 Loomis is reported as having telephoned by induction over a distance of 20 miles between the tops of mountains.

The methods which have been causing much interest in recent years are those depending on the radiation of electric waves, developing the ideas of Maxwell, and the experiments of Hertz. Marconi, with the help of Preece and the British telegraph department, has succeeded in telegraphing messages as far as 31 miles without any connecting metallic conductor.

The telegraph was used for the special purpose of a fire-alarm system, at an early date after its introduction for public use. Dr. Channing urged its use for this purpose as early as 1839, and in 1851, he succeeded in getting an appropriation from the city of Boston for the purpose of putting in an electric fire-alarm system. From this the Gamewell system and others have been developed to their present high state of perfection.

Police telegraph and telephone systems, automatic block-signal systems, burglar alarms, time systems and numerous other applications of the telegraph might form subjects for lengthy discussions.

Optical, like acoustic methods of communication, may be divided into transient or permanent, accordingly as a record is left. Ethnologists believe that primitive man conversed by means of signs more than by means of sounds. Certain it is that among uncivilized tribes at present the language of signs seems to be well nigh universal. The flag or its equivalent probably came into use very early. Fire was early used for signaling purposes as noted by Homer and Æschylus in their accounts of the reports of the fall of Troy. Jeremiah (588 or 612 B. C.) calls upon the Jews to set up a sign of fire as a warning. In later times we recall the warning hung up for Paul Revere, also the common practice of the American Indians. Attempts were made to use fire signals to convey more definite and complicated messages than simple alarms. Polybius (204–122 B. C.) gives an extended account of the methods used by the ancients for telegraphing, including an account of his own plan for spelling out letters and words by a system of torches.

Since the days of Polybius, various schemes have been devised for sending messages by sets of signals by which words might be spelled out letter by letter. Interesting accounts of these have been written by Shaffner, Reid, Baily, Wetter, Belloc and others.

The "wig-wag" system of signaling by flags or torches and the heliostat system of using the light of the sun or of an arc lamp, are discussed by Wetter and Maver, also in the books on tactics. The heliograph sometimes has a range as far as 100 miles when an eight-inch mirror is used.

Semi-transient visual methods of communication include the use of flags or lights as distinguishing marks for ships, railway semaphores, weather signals, cards for calling express or delivery wagons, blackboard notices, posters and the like; also most forms of recording telegraph, including recording measuring instruments, watchmen's recorders, conductor's indicators, calling devices in telephone exchanges and annunciators such as used in hotels and elevators. Lighthouses have been in use since the Pharos was built at Alexandria, Egypt, about 300 B. C., or since the siege of Troy, about 1080 B. C., when a signal light was maintained near the Dardanelles.

Methods of visual communication, in which the means are permanent, are usually classified under reminders, ideograms and phonograms, including the whole science of written language. It is considered that, in the development of written language, various sorts of devices were used simply as reminders, having little or no inherent connection with the idea to be remembered. The earliest recorded use of such reminder was the mark of warning placed upon Cain. Later followed the rainbow given as a promise to Noah. Holes dug in the ground, notches cut in sticks or trees, strings tied about a finger, sticks put in the pocket and the like, serve simply to remind one that some definite thing is to be remembered. Notches cut in sticks, knots in cords, beads on rosaries to serve as means of counting, blazes cut in trees to indicate roads or trails, all indicate steps toward a more close connection between the sign and the thing to be remembered or communicated to others. Landmarks have been heeded since early times. Rude pictures are found in the relics of earliest prehistoric tribes, developing into regular systems of picture writing, interesting examples of which are to be found in the works of our American Indians. Pictures (or ideograms) soon began to be conventionalized and simplified, then to be used for expressing more or less abstract ideas. Soon symbols were used for sounds and the phonogram came into use. Symbols came to be used to represent entire words, as with the Chinese, or syllables, as with the Japanese and some Indian tribes; finally letters came into use. The development of the alphabet has been discussed in an interesting style by Taylor.

Methods of sending written communications have been in use from an early date. Regular relays of messengers were used by Cyrus the Great. Jeremiah (about 595 B. C.) seems to have been familiar with such a system, for in his prophecy he declared that "one post shall run to meet another and one messenger to meet another to show the king of Babylon that his city is taken." The account in Esther a few years later (510 B. C.) states that Mordecai "wrote in the King Ahasuerus's name and sealed it with the king's ring and sent letters by posts on horseback, etc.," to the 127 provinces of the kingdom. The history of the postal system from that time to the present day forms an interesting chapter in the development of civilization. An excellent account of ancient posts and of the development of the English postal system is given by Tegg in his "Posts, Telegraphs and Telephone." The growth of the United States mail service is told by Cushing in "The Story of Our Post Office," also in the encyclopedia under "Postal Service." A comprehensive discussion of this subject would involve us in a study of foot and mounted couriers, wagons, railway systems, street cars, carrier pigeons, steamships and sailing vessels—in fact, every means of transportation.

The transmission of intelligence, like the transportation of persons and goods, is one of the greatest factors in civilization.

Don't Try to Telephone This Address!

In answer to inquiries from several correspondents in the United States, Consul Nelson, of Bergen, writes, under date of June 28, 1899, that tenders for railroad supplies for state railroads in Norway should be addressed to Styrelson för Statsbanernas Drift og Anlaeg Christiania.

ADVANCE INFORMATION

New Electric Railways.

INDIANAPOLIS, IND.—The Broad Ripple Traction Company has been incorporated, with a capital stock of $100,000. Incorporators: John B. Warner, president; John T. Burnett, Elbert B. Peck, Clarence Winter, John D. Thompson, Randall Morgan and George S. Philler.

LANSING, MICH.—The Wisconsin Central Railway Company has been incorporated. The company is capitalized at $30,000,000.

NORTHBRIDGE, MASS.—The selectmen of Northbridge have granted a license to the Linwood Street Railway Company to operate an electric road from Whitin's Depot to Whitinsville, a distance of a mile and a half. The road will be built at once.

BOSTON, MASS.—A charter has been issued to the Blue Hill Street Railway Company. It is to run from the terminus of the Brockton Street Railway in Stoughton through Sharon, Canton and Milton to the line separating Milton from Boston and Milton from Hyde Park. The capital is $150,000. The incorporators are Charles A. Stone, E. J. B. Huntoon, C. H. French, W. Cameron Forbes, W. E. C. Swan, E. S. Webster.

EASTON, MASS.—The Easton Street Railway Company has been incorporated. The line will run from the Stoughton line to Central, with a right to connect with the Brockton Street Railway. The Stoughton & Randolph Street Railway Company has also been incorporated. The line will run in Easton, through Stoughton and Randolph, to the Holbrook line.

OWENSBORO, KY.—The right of way has been secured for the electric railroad from this place to Calhoon, and the road is considered a certainty. A Boston firm of capitalists has offered to take the bonds of the road to the amount of $300,000. The estimated cost is $120,000 per mile of railroad track. The length of the road will be 25 miles. The extension of the road from Calhoon to Madisonville is being agitated.

ALBANY, N. Y.—The Dunkirk & Point Gratiot Traction Company, to operate a street surface electric road in the city of Dunkirk to the shores of Lake Erie, at Point Gratiot, has been incorporated with a capital of $25,000. The directors are Jotham C. Haggett, Lester F. Stearns, William Bookstaver, M. L. Hinman, E. D. Warner, A. J. Lunt and C. J. Carney, of Dunkirk; A. H. Marsh, of Fredonia, and S. Fred Nixon, of Westfield.

ROCKVILLE, MD.—A charter has been granted to the Silver Spring & Sandy Spring Railroad Company for passenger and freight traffic, as well as electric light and telephone communication between the two points in Montgomery county. The amount of capital stock is $50,000. The incorporators are Warren Choate, of Rockville, Alexander T. Hensey, of Washington, and Henry Nichols, Allan Fres and W. P. Springer, of Silver Spring. The road, it is said, will be built with New York capital.

CLEVELAND, OHIO—The Hancock County commissioners have granted a franchise to the Findlay, Fostoria & Toledo Electric Railway, and the road will be built to Fostoria this Fall and Toledo in the Spring.

SOUTH BEND, IND.—George R. Bullard and C. E. Sawyer, railway promoters of Marshall, Mich., are to build an electric railway from South Bend to Michigan City, via New Carlisle and Laporte. Their object is to make connection with the lines of the Indiana Railway Company between this city and Goshen. The latter line will begin operations in a few days.

COLUMBUS, OHIO—The Xenia & Cedarville Railway Company has been incorporated by Clarence P. King, J. W. Neff, Morris Sharp, Ollie Dodds and John C. Cullett; capital stock, $40,000. They will build an electric line between the two cities by way of Wilberforce.

JEFFERSON CITY, MO.—A charter has been granted to the County Belt Railway of St. Louis, with a capital stock of $1,000,000. The incorporators are John C. Wilkerson, C. P. Walbridge, Thomas Wright, W. S. Fleming, Nathan D. Thompson and Louis W. Post. The road is to be 30 miles in length, and to encircle the city, beginning at a point on the St. Louis, Keokuk & Northwestern Railroad, in St. Ferdinand Township, and running around the city to a point on the line of the St. Louis, Iron Mountain & Southern Railroad, between Jefferson Barracks and St. Louis. The purpose of the road is to provide complete and convenient connections, accommodation and terminal facilities in St. Louis county and city for all railroads now entering or which may hereafter enter said city or county. The directors are J. C. Wilkerson, C. P. Walbridge, Thomas Wright, W. S. Fleming and Nathan D. Thompson.

New Telephone and Telegraph Companies.

CHEYENNE, WYO.—The Postal Telegraph Cable Company has been incorporated; incorporators, T. B. Hicks, G. Clark, C. W. Riner, all of Cheyenne.

ABERDEEN, S. D.—The Dakota Central Telephone Company has made a deal by which they absorb the lines of the Midland Telephone Company. These lines extend from Ellendale to Kulm, Luddin, Oaks, LaMoure, Edgley, Frederick and intermediate points.

JOHNSON, NEB.—The Johnson Telephone Company, with a capital stock of $3,000, has been incorporated; the principal stockholders are C. E. Clagett, J. F. Holgrew and C. C. Stone; the other stockholders are J. M. Anderson, E. G. Mann, J. G. Ramsey, R. S. Scofield, Daniel Casey and Louis Lintz.

SHARON, PA.—The lines of the Union Telephone and Telegraph Company, of Erie, and the Mercer County Telephone Company will be connected within 10 days and the service extended to Pittsburgh and Cleveland. Thousands of dollars are to be expended for repairs, and the new company will be a strong competitor of the Bell Telephone Company.

ALDEN, N. Y.—The Alden Telephone Company has been formed to establish a local telephone exchange, and to connect some of the nearby towns with Alden by telephone.

DARLINGTON, IND.—The Darlington Telephone Company has been incorporated, with a capital stock of $1,000. The directors are Daniel Lewis, V. E. Craig, T. M. Campbell, J. A. Patterson, John Patterson, R. C. Dunnington and L. W. Little.

CAMBRIDGE, MD.—A new telephone line will be built between this place and Taylor's Island.

GOWANDA, N. Y.—William R. Smallwood has just completed his telephone line to Collins. This connection gives him a complete system, connecting Iroquois, Perrysburg, North Collins, Lawton and Versailles. Work will commence very soon on a line to Silver Creek, connecting at Ruggtown with the Silver Creek telephone line.

Electric Light and Power.

NORTHVILLE, MICH.—The question of bonding the village for $27,500 for the purpose of purchasing an electric lighting plant carried at a special election held here a few days ago by a vote of 317 to 12.

TORONTO, ONT.—The McLachlan Electric and Gasoline Motor Company, Limited, has been incorporated. The provisional directors are Messrs. John C. McLachlan, Charles Millar and Charles William Vernon.

CATSKILL, N. Y.—The Catskill Mountain Electric Company, to furnish light for the villages of Pine Hill, Griffins Corners, Fleischman, Arkville, Margaretville and Arena, in the counties of Ulster and Delaware, has been incorporated; capital, $100,000; directors, John M. Blish, of Fleischman; George H. Lasher, of Griffins Corners; Charles C. Kaufmann, Andrew J. Kaufmann, of Margaretville.

ALBANY, GA.—A complete electric power plant will be erected on the banks of the Kinchaffionee creek to supply motive power for the new cotton factories and other plants to be erected here.

PORTERVILLE, CAL.—The Porterville Light and Power Company has been incorporated; directors, W. H. Hammond, A. G. Wishon, A. D. Wilson, J. R. Jones, J. F. Boller, Porterville; capital, $10,000.

New Incorporations.

TRENTON, N. J.—The Beacon Contracting and Construction Company has been incorporated; objects, construct gas works, electric light plants, etc.; capital $125,000.

The Boy, the Balk and the Battery.

[*From the Cincinnati Enquirer.*]

Wm. Gehrke, a young man living near Napoleon, is minus several teeth, has a broken jaw, a badly disfigured face and numerous bodily injuries, the result of a number of kicks registered by a horse, who was the victim of an electrical experiment, which was being applied by the 19-year-old boy.

An article was recently published in a farm journal concerning a Pennsylvania gentleman, who owned a horse that would have been valuable but for what seemed a vice for balking, and how the owner cured the fractious animal by means of an electrical battery. Gehrke, Jr., read the article and concluded to experiment with such a contrivance.

A small storage battery, a push-button and wire was purchased and rigged up on a buckboard, to which the animal was attached. As was anticipated, the horse refused to budge. Young William, who was seated in the car, looked at his father, who was an interested spectator, and giving him a knowing wink, said: "Now see the fun, Dad," touching the button connected with the battery.

The amateur horse trainer's mind was a blank from the moment his fingers came in contact with the button, and remained so for over an hour. Dr. Harrison, who was called to restore the young man to citizenship and life, was given a detailed account of the electrical experiment by Gehrke, Sr., who said: "When Willie touched that button that colt gave a snort, kicked and jumped like she was possessed. She became so lively that I don't know just how it all did happen. Poor Will laid there on the ground; his face was white and his nose was bleeding. I thought he was dead. I got a bucket and poured water all over him. The buckboard was on top of the fence, and the colt was going down the road at a Nancy Hanks gait."

When asked how the electricity had been applied, the doctor was told: "Just the way it says in the paper. He connected the wires from the battery to the bit and cruppers."

Young Gehrke was in town yesterday, his face swathed in bandages and plasters, and, with the left arm in a sling, was looking for a horseman to break the colt. He has no faith in electricity for balky horses, and says that the West Pennsylvania Humane Society doesn't know what it is indorsing when it approves of such methods in the name of humanity. "Look at me now! Why, I take my food through a nursing bottle, and Dr. Harrison says I will have to continue to do so for four or five weeks yet, at least."

Gehrke, Sr., looking fondly at Gehrke, Jr., said: "Electricity for automobiles may be all right, but for balky colts it's no good. Is it, Willie?"

STANDARD THERMOMETER & ELECTRIC CO.,

Main Office, PEABODY, MASS.

NEW YORK OFFICE, 141 Broadway, W. J. BRAMHALL, Resident Mgr.
CHICAGO OFFICE, 313 S. Canal Street, GEO. H. STOUT, Resident Mgr.

General European Agents, H. M. SALMONY & CO., LTD., LONDON.

ARC LAMPS (OPEN AND ENCLOSED)

FOR ALL CIRCUITS.

THE UPTON "MIDGET" ENCLOSED ARC.

No. 370.

BEST IN THE MARKET.
STEADY WHITE LIGHT.

Single or Double Globe Arrangement.
No Parts to Wear or Get out of Order.
BURNS 125 to 150 HOURS.

Send for Bulletins "Series B."

AGENCIES IN ALL THE LARGE CITIES.

Anchor Switches

We Sell 'Em

Anchor Snap Switches
Anchor Snap Key Switches
Anchor Snap Flush Switches
Anchor Snap Flush Key Switches
Anchor Indicating Snap Switches
Anchor Push Button Flush Switches
Anchor Push utton Flush Key Switches
Iron Wall Boxes for Anchor Flush Switches
Anchor Automatic Door Switches
Anchor Flush Switches Furnished In Gangs of Any Number

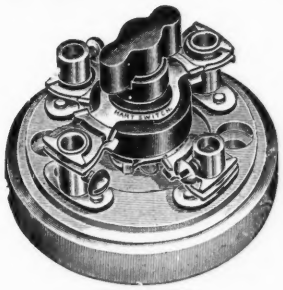
COMPLETE STOCK CARRIED

Michigan Electric Co.

Michigan's Great Electrical Supply House

Detroit, Michigan

Hart "Standard" Switch.



COVER REMOVED.

You Don't Find Hart Switches in Scrap Heaps or on Bargain Counters.

CAUTION. To guard against fraud, all Hart Switches have the words "Hart Switch" stamped in the metal. When you order Hart Switches, make sure that this stamp is on switches received, as inferior switches are sometimes substituted when Hart Switches are ordered.

SOLD BY DEALERS EVERYWHERE.

THE HART & HEGEMAN MFG. CO.
108 HIGH STREET, HARTFORD, CONN.

SINGLE CYLINDER .....CARBON CELL.

COMPLETE,

50 in a Bbl.

THE CARBON, THE ZINC, THE SAL-AMMONIAC,
THE METAL CONNECTIONS, THE BUSHING,
THE GLASS JAR (Round or Square), THE PARAFFINING,

are all kept to the highest standard of QUALITY—but the price is cut way down to 18 cents.

Write us for DISCOUNTS on THIS PRICE.

Phoenix Battery Mfg. Co.,

ST. LOUIS, MO.

VALUABLE ELECTRICAL BOOKS.

ELECTRIC LIGHT AND POWER.

Allsop's "Practical Electric Light Fitting;" a treatise on electric light wiring and fitting. Price..... $1 50
Noll's "How to Wire Buildings." Price..... 1 50
Crocker-Wheeler's "Practical Management of Dynamos and Motors;" description and directions. Price..... 1 00
Buckley's "Electric Lighting Plants;" cost and operation. Price, 2 00
Crocker's "Electric Lighting;" for the use of electricians, students and others interested in the installation or operation of electric lighting plants. Price..... 3 00
Latimer's "Incandescent Electric Lighting;" a practical description of the Edison system. Price..... 50
Unwin's "Development and Transmission of Power from Central Stations;" a new and timely book. Price..... 3 50
Bell's "Electric Power Transmission;" a practical treatise for practical men. Price..... 2 50
Atkinson's "Elements of Electric Lighting." Price..... 1 50

ELECTRIC RAILWAY.

Perry's "Electric Railway Motors;" their construction, operation and maintenance. Price..... 1 00
Merrill's "Reference Book of Tables and Formulas for Electric Street Railway Engineers." Price..... 1 00
Trevert's "Electric Railway Engineering;" embracing practical hints upon power-house, dynamo, motor and line construction; for the use of students. Price..... 2 00

TELEPHONE.

Allsop's "Telephones: Their Construction and Fitting." Price..... 2 00
Hopkins's "Telephone Lines and Their Properties;" design and construction of city lines. Price..... 1 50
Poole's "Practical Telephone Hand-Book." New edition. Price... 1 50
Webb's "Telephone Hand-Book." Price..... 1 00
Haskins's "Telephone Troubles and how to Find Them;" a complete hand-book for telephone inspectors. Price..... 25
Bennett's "Telephone Systems of Europe;" new and very complete. Price..... 4 50
Preece & Stubb's "Manual of Telephony." Price..... 4 50
Houston & Kennelly's "Electric Telephony." Price..... 1 00
Cary's "How to Make and Use the Telephone." Price..... 1 00

X RAY.

Meadowcroft's "A B C of the X Rays." Price..... 75
Thompson's "Roentgen Rays and Phenomena of the Anode and Cathode." Price..... 1 50
Morton & Hammer's "The X Ray, or Photography of the Invisible." Price..... 50
Trevert's "Something about X Rays for Everybody." Price..... 25
Norrie's "Ruhmkorff Induction Coils." Price..... 50

MISCELLANEOUS.

Cushing's "Standard Wiring." Price..... 1 00
Thomson's "Dynamo Electric Machinery." Price..... 6 00
Meadowcroft's "A B C of Electricity." Price..... 50
Tesla's "Experiments with Alternate Currents of High Potential and High Frequency"—A Lecture with biographical sketch. Price. 1 00
Edison's "Life and Inventions;" by W. K. L. and A. Dickson. Price..... 4 50
Trevert's "How to Build Dynamo Machinery." Price..... 2 50
Parkhurst's "Electric Motor Construction for Amateurs." Price... 1 00
Benjamin's "Age of Electricity—From Amber-soul to Telephone." Price..... 2 00
Foster's "Central Station Bookkeeping." Price..... 2 50
Houston's "Dictionary of Electrical Words, Terms and Phrases." Price..... 5 00
Replogle's "Electricity and Water-Power." New. Price..... 1 00
Ayrton's "Practical Electricity;" for first year students of electrical engineering. New. Price..... 2 50
Grier's "Note-Book of Wiring Tables;" How they are made, and how to use them. Price..... 1 00
Hawkin's "New Catechism of Electricity." Price..... 2 00

All of these books sent prepaid on receipt of price. Address

ELECTRICAL REVIEW PUBLISHING CO.,

P. O. Box 2339. 41 PARK ROW, NEW YORK.

PATENTS TRADE-MARKS COPYRIGHTS

EDWARD S. DUVALL,
Solicitor of Patents,
Counsellor in Patent Causes.

Some time connected with the late Benjamin Butterworth, before he retired from practice to assume the office of Commissioner of Patents.

Prompt attention given to all matters before the Patent Office, and applications for patents prepared here at Washington from sketches, photos, or models, in a manner to give highest satisfaction and with less expense than you will incur elsewhere. Write and convince yourself of this fact. As an attorney at Washington is indispensable you can save the expense of having two by communicating directly with me.

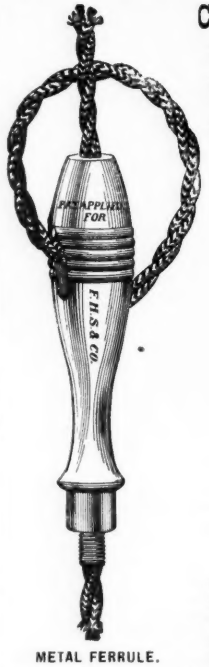
LOAN AND TRUST BUILDING,
WASHINGTON, D. C.

YOU CAN GET A PATENT
For any invention. Send me particulars and a rough sketch for advice, free by return mail.

IMPORTANT to have your attorney at Washington, saving time and expense.

HENRY S. THORNBERRY, Patent Solicitor,
1427 F STREET, N. W., WASHINGTON, D. C.

The STEWART
Combination Socket Handle and Adjuster.



METAL FERRULE.

It speaks for itself. Send for Sample. Takes all strain from the socket connections.

FRANK H. STEWART & CO.
7th and Filbert Sts., Philadelphia, Pa.

JUST WHAT YOU NEED
The Incandescent **ELECTRIC LIGHT MANIPULATOR**

For cleaning and renewing Incandescent Lights situated in high places. Made to fit any candle-power bulb of any standard make.

JUST WHAT IS NEEDED
for Hotels, Depots, Halls, Theatres, Public Buildings, Street Lights, Stores, Fine Residences, Etc.

Send for description and prices.

MANUFACTURED AND FOR SALE BY
Incandescent Electric Light Manipulator Co.
Room 800
116 Bedford St. BOSTON, MASS.

DESIGNERS AND ENGRAVERS
BY ALL METHODS
Electrical Machinery and Apparatus
A SPECIALTY
GET OUR PRICES AND SPECIMENS BEFORE BUYING.
THE BROWN-BIERCE COMPANY.
DAYTON, OHIO.

IF THE BEST IS NOT TOO GOOD FOR YOU
YOU WILL BE SATISFIED WITH
The Telephone Magazine
...FOR 1899...

If you are interested in the operation or Construction of **Exchanges, Line Construction, Interior Wiring, Modern Exchange Apparatus, Telephone Troubles** and **How to find them,** or in any other branch of Telephony, send us **A DOLLAR BILL** with your name and address and the Magazine will reach you regularly for a year.

Sample copies free.
Special rates to Agents and Clubs.

Electrical Engineering Publishing Co.
Monadnock Block, CHICAGO.

NEWSDEALERS SELL IT.

Our NEW IMPROVED BATTERY keeps the
American Electric Vehicle Co.
IN THE LEAD — PIONEERS ALWAYS
Send for Catalogue of Carriages
56-58 West Van Buren St. Chicago, U. S. A.

ALL VOLTAGES

ANY CANDLE-POWER

Dixon's Pure Flake Graphite
Is a Blessing to Every Engine Room and Machine Shop.
A small quantity added to any Oil or Grease largely increases its lubricating value and makes the finest Cooling Mixture.
Pamphlet and Sample Sent Free.
JOS. DIXON CRUCIBLE CO., Jersey City, N. J.

Kansas in the Philippines

Is making a reputation for courage and patriotism that stirs our blood.

Kansas in the Cornfields,

Wheatfields and orchards has already made a reputation for gigantic yields that astonishes the world. Oil wells, coal, lead and salt mines furnish a basis for industrial development. Send for free copy of

"What's the Matter

With Kansas?" and for information about homeseekers' excursion tickets via Santa Fe Route

Address General Passenger Office,
The Atchison, Topeka & Santa Fe Railway,
CHICAGO.

"How to Become an Electrical Engineer."

PRICE 25 CENTS.

Paper, Pocket Size.

Prize essays giving practical advice to young men *deciding upon a career.* List of colleges teaching electrical engineering. Address

Electrical Review, Times Bldg., N. Y.

Spanish-American War Panorama and Greater America

is one of the war books which is likely to be in continuous demand. It is a panoramic record of the triumph of Yankee Doodle. The eagle flaps his wings on every page, and "Old Glory" waves around and above every scene. Prominent officers connected with the war are here portrayed, as well as many of the "men behind the guns." Military life is pictured to the eye, from recruiting to guard mount and skirmish line. Nor is the ludicrous omitted. The company cook receives the attention due to his importance; the mess is shown; cavalry scenes are given; the hospital arrangements are depicted; the heroines of the Red Cross service are displayed; street scenes in Havana, Santiago and elsewhere are unrolled; the new citizens or subjects (which are they?) of Uncle Sam appear and disappear as the leaves are turned.

In a word, the gazer visits the new localities and sees the tumultuous new life, without the risk or expense of a sea voyage.

The Album is 5½x8 inches, weighs 12 ounces, printed on finest coated paper.

Mailed to any address in the United States, Canada or Mexico, for 12 cents to cover postage and packing. Copy may be seen at any ticket office of the Big Four Route.

Order at once, as the edition is limited.

Address WARREN J. LYNCH, General Passenger and Ticket Agent, "Big Four Route," Cincinnati, Ohio.

Mark envelope "War Album."

THE ONLY WAY
TO REACH
THE READERS
OF THE

Electrical Review

IS THROUGH THE

Electrical Review

ITS READERS
ARE WORTH
REACHING, TOO.

A REQUEST TO 41 PARK ROW, NEW YORK, WILL BRING FULL PARTICULARS.

CHAPMAN VOLTAGE REGULATORS

For ALTERNATING or DIRECT CURRENT SYSTEMS.

Insure *STEADY LIGHTS* in spite of *CHANGING SPEED* and *VARYING LOADS.* They *COMPENSATE* for *LINE LOSS* and automatically keep a constant Voltage at any chosen center of distribution, however distant. Write for particulars.

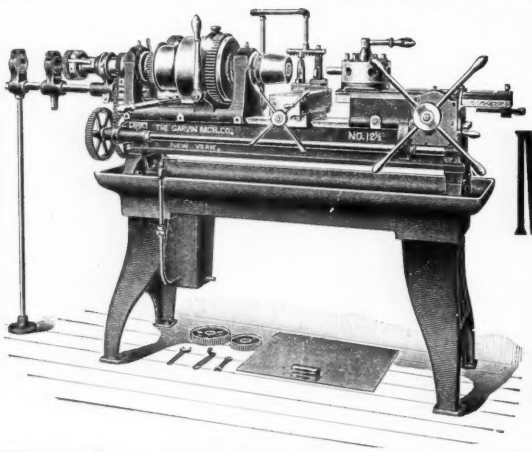
We also manufacture Water Motors, Electric Motors and Dynamos in the Bipolar and Multipolar types. Copper Mills with water and electric attachments.

REGULATORS SENT ON 30 DAYS' TRIAL.

SOLE MANUFACTURERS, **BELKNAP MOTOR COMPANY,**

PORTLAND, - - - MAINE.

Branches: Boston, New York, Philadelphia, Chicago, St. Louis, Milwaukee, Toledo, Denver, San Francisco.



Screw Machines

WITH ALL COMBINATIONS OF ATTACHMENTS.

ALL KINDS OF **Machine Tools.**

Catalogue.

The Garvin Machine Co., Spring & Varick Sts., NEW YORK.

Philadelphia Store, THE GARVIN MACHINE CO., 51 North 7th Street, Philadelphia, Pa.

Berlin Store, THE GARVIN MACHINE CO., m. b. H., 17 Burg Strasse, Berlin, C., Germany.

MATCHLESS ELECTRIC LIGHTER!

MAKE MONEY QUICK.

AGENTS WANTED. Electric Light or Battery Current.
Endorsed by Fire Underwriters. A practical Electrical Novelty.
Sells at Sight. SPECIAL PRICES TO THE SUPPLY TRADE.
Send for Descriptive Circular.

STANLEY & PATTERSON, General Electrical Equipment Supplies, **32-34 Frankfort St., New York.**

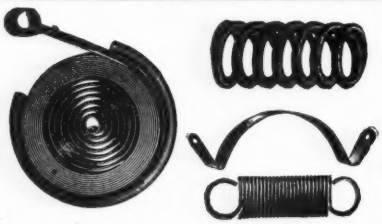
LATHES, PUNCHES AND SHEARS.

Send for Price-List and Catalogue.

W. C. YOUNG MFG. CO.,

Box 1123, WORCESTER, MASS.

Telegraph Address, Young Worcester. Western Union Code Used.



CARY SPRING WORKS,

240 & 242 WEST 29th STREET NEW YORK CITY.

Manufacturers of

WIRE and SPRINGS

For Machinery, Motors, Clocks, Music Boxes, and all kinds of Electrical Purposes.

RUBBER COVERED

WIRES AND CABLES FOR EVERY SERVICE.

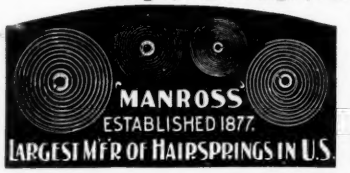
For Underground, Aerial and Submarine use, "Safety" wires and cables have the indorsement of some of the largest users in the United States. Write for our booklet containing the experience of users.

THE SAFETY INSULATED WIRE & CABLE CO.,
225 to 239 West 28th Street, New York.

LEONARD F. REQUA, General Manager.

HAIR SPRINGS

For Electric Indicating and Recording Gauges, Steam Gauges, etc.



Non-Magnetic Hair Springs of Phosphor-Bronze and other non-magnetic metals.

Hair Springs of any description manufactured to order.

F. N. MANROSS, Forestville, Conn.

Full of Life and Even Temper!
SMALL
SPRINGS
OF EVERY DESCRIPTION MADE BY
THE WALLACE BARNES CO.
BRISTOL, CONN., U. S. A.
ESTABLISHED 1857
FLAT OR ROUND WIRE. STEEL OR BRASS. A complete assortment of high-grade COLD ROLLED STEEL kept in stock, .003 to .049 inch thickness.
Springs enameled or plated. Tempering done at short notice. Ribbon steel made to order.
Send samples and write for quotations.

FOREST CITY ELECTRIC CLEVELAND O. **ROLL DROP** COMMUTATOR BARS HAVE STOOD THE TEST OF TIME

There Is No Higher-class
India-rubber Insulation
For Wires and Cables than

Habirshaw.

Widely Used, Universally Liked,
Specified in Best-grade Installations.

The India Rubber and Gutta Percha Insulating Co.,
Main Office, Glenwood Works,
YONKERS, N. Y.

J. W. GODFREY, Manager Sales,
15 Cortlandt Street, New York.

Sawyer-Man
INCANDESCENT LAMPS
give better satisfaction than any other lamp on the market.
All principal Supply Houses.
Sawyer-Man Electric Co.,
Allegheny, Pa.
175-c.

BUCKEYE INCANDESCENT LAMPS
QUALITY UNEQUALED.
THE BUCKEYE ELECTRIC CO.,
11 Broadway, NEW YORK. 753 Monadnock Building, CHICAGO. 552 The Bourse, PHILADELPHIA. 524 Tremont Building, BOSTON.

INDEX OF ADVERTISERS.

A

	PAGE
Allen & Co., L. B	xvi
Ambor, J	xix
American Battery Co	
American Bell Telephone Co	xxi
American Electrical Heater Co	vii
American Electric Telephone Co., long-distance telephones	xxii
American Electric Vehicle Co	xi
American Electrical Works, insulated wire	i
American Endoscopic Co	vi
American Engine Co	vii
American Vitrified Conduit Co	i
Atchison, Topeka & Santa Fe Railway	xi

B

Babcock & Wilcox Co	xxiv
Baker & Co., platinum	xvi
Ball & Wood Co., engines	xix
Barnes Co., The Wallace	xii
Barron, Jas. S., & Co	i
Belknap Motor Co	xii
Bibber-White Co	viii
"Big Four Route"	xi
Billings & Spencer Co	
Boker & Co., Hermann	vi
Bossert Electric Construction Co	viii
Brady, T. H	xv
Bristol Co	i
Brown-Bierce Co	x
Buckeye Electric Co	xiii
Bullock Electric Manufacturing Co	
Bunnell & Co., J. H., dry batteries	iii

C

Cary Spring Works	xii
Camp Co., H. B	xvii
Central Electric Co., electrical supplies	ii
Central Manufacturing Co	xvii
Central Telephone & Electric Co	xxiii
Connecticut Telephone and Electric Co	xxi
Crefeld Electrical Works	i
Crocker-Wheeler Electric Co	i
Cutler-Hammer Manufacturing Co	

D

Diehl Manufacturing Co	
Dixon, Jos., Crucible Co., belt dressing	xvi
Duval, E. S., Jr., patents	x

E

Eastern Electric Cable Co	xv
Edison Manufacturing Co	xxi
Electric Appliance Company, supplies	i
Electric Storage Battery Co	iii
Electrical Engineer Institute of Correspondence Instruction	
Electrical Engineering Publishing Co	x
Emerson Electric Manufacturing Co	viii
Empire China Works, porcelain specialties	viii
Ericsson Telephone Co	i
Eureka Electric Co	vii

F

Faris & Thayer	xvii
Forest City Electric Works	xii
For Sale	
Fort Wayne Electric Works	iv
Frink, I. P	vii, xxiv

G

G. & E. Electric Co	viii
Garvin Machine Co	xii
General Electric Co	ii
General Incandescent Arc Light Co	vii
Gordon, A. Y	xxi
Greene, B. E	xvii

H

Hart & Hegeman, electric switches	ix
Hart Manufacturing Co	vii

I

Incandescent Electric Light Manipu'at r Co	x
India Rubber and Gutta Percha Insulating Co	xiii
International Correspondence Schools	xviii
Ironclad Resistance Co	xvii

J

Jones, J., & Son	iii

K

Kartavert Manufacturing Co	xvi
Keystone Electrical Instrument Co	xv
Klein & Son, Mathias	xvii

L

Large & Co	viii
Leffel & Co., James	xv
Lombard Water-Wheel Governor Co	xv

M

Machado & Roller	
Maintenance Co., The	xxiv
Manross, F. N	xii
Marshall, Wm., condensers	xxii
McCay Engineering Co	xxiv
McIntire Co., The C	vi
McIntosh, James D	xxiv
McKenney & Waterbury	i
Meserve, F. W	iv
Meyrowitz, E. B	xix
Mianus Electric Co	xxiii
Michigan Electric Co	ix
Michigan Pipe Co	xviii
Mona Manufacturing Co	vii
Montauk Multiphase Cable Co	i, viii
Morris, Electric Co	i
Munsell & Co., Eugene	i

N

National Carbon Co	xvi
National Conduit & Cable Co	i
National India Rubber Co	vii
National Ore & Reduction Co	xvii
New England Butt Co	vi
New England Engineering Co	iv
New York & Ohio Co	i
New York Insulated Wire Co., Grimshaw wires and cables	i
New York Telephone Co	xxii
North Electric Co	xix, xxii
Novelty Electric Co., supplies	xvi

O

Ohio Electric Specialty Manufacturing Co	viii
Ohio Electric Works	xix
Okonite Co., insulated wires and cables	i, xxiv
Ostrander, W. R., & Co., supplies	xix

P

Paiste, H. T., Co	viii
Pelton Engineering Co	xix
Phœnix Battery Manufacturing Co	ix
Phœnix Glass Co	i
Phillips Insulated Wire Co	xxiv
Purdue University	xvii

R

Reliable Electric Manufacturing Co	
Ritchie & Sons	vi
Roberts Electric Supply Co	xvii
Roebling's Sons Co., John A	vi
Rose Polytechnic Institute	xvii

S

Safety Insulated Wire & Cable Co	xii
Samson Cordage Works	xxiv
Sawyer-Man Electric Co	xiii
Schiff, Jordan & Co	xvi
Shelby Electric Co	xi
Siemens & Halske Electric Co	
Simplex Electrical Co	i
Sperry, B. N	xxiv
Splitdorf, C. F	i
Sprague Electric Co	
Standard Paint Co	xvi
Standard Thermometer & Electric Co	ix
Standard Underground Cable Co	i
Stanley & Patterson	xii
Stewart, Frank H., Co	x
Sterling, C. B., & Co	xxi
Sterling Electric Co	xxii
Sterling Supply & Manufacturing Co	iii
Stirling Co., water-tube boilers	xxiv
Stromberg-Carlson Telephone Mfg. Co	xxiii

T

Taber & Mayer	xv
The Telephone Manufacturing Co	xxii
Thornberry, Henry S	x

U

United Correspondence Schools	xviii
U. S. Mineral Wool Co	

V

Viaduct Mfg. Co., telephones, etc	xxii

W

Wanted	xvii
Ward Leonard Electric Co	xvii
Warren Electric & Specialty Co	i
Webster, Geo. G	xvii
Webster Warren & Co	xvii
Western Electric Co	v
Western Telephone Construction Co	xxiii
Westinghouse Electric & Mfg. Co	xxiii
Williams-Abbott Electric Co	xxi
Williams Electric Co	
White & Co., J. G., engineers and contractors	xvii
Whitney Electrical Instrument Co	
Wyckoff Creosoting Co	xvi

Y

Young, W. C., Mfg. Co	xii

CLASSIFIED LIST.

Alternators.
General Electric Co.
Westinghouse Electric & Mfg. Co.

Batteries, Primary.
Bunnell & Co., J. H.

Batteries, Storage.
American Battery Co.
Electric Storage Battery Co

Battery Material.
Bunnell & Co., J. H.

Bells.
Ostrander & Co., W. R.

Belt Dressing.
Dixon Crucible Co., Joseph

Boilers.
Babcock & Wilcox Co., The
Stirling Co., The

Books, Technical.
Electrical Review Pub. Co.

Braiding Machines.
New England Butt Co.

Brokers.
Faris & Thayer.
Greene, B. E.

Brushes, Dynamo.
Crown Woven Wire Brush Co.
Goldmark & Wallace.
Hobart Electric Mfg. Co.
Ohio Electric Specialty Mfg. Co.

Cable Hangers.
Standard Underground Cable Co.

Cabling Machines.
New England Butt Co.

Carbon Points.
General Incandescent Arc Light Co.
National Carbon Co.

Castings.
Billings & Spencer Co.
New England Butt Co.

Circuit-Breakers.
Ward Leonard Electric Co.

Coal Mining Machinery.
General Electric Co.

Commutator Bars and Repairing.
Forest City Electric Works.

Commutator Lubricant.
Mona Manufacturing Co.
Ohio Electric Specialty Mfg. Co.

Condensers (Electric).
Marshall, Wm.

Conduits.
American Vitrified Conduit Co.
Camp Co., H. B.
Michigan Pipe Co.
National Conduit & Cable Co.
Wyckoff Creosoting Co.

Connectors and Terminals.
McIntire Co., The C.

Cord Electric.
Samson Cordage Works.

Contractors.
Webster, Geo. G.

Desk Lamps.
Pacific Electric Co.

Dynamos and Motors.
Bullock Electric Mfg. Co.
Central Electric Co.
Crocker-Wheeler Electric Co.
General Electric Co.
General Incandescent Arc Light Co.
Lincoln Electric Co.
Warren Electric Manufacturing Co.
Westinghouse Electric & Mfg. Co.

Electric Locomotives.
General Electric Co.

Electric Novelties.
Ohio Electric Works.

Electric Heaters.
American Electrical Heater Co.

Electrical Instruments.
Bossert Electric Construction Co.
Central Electric Co.
General Electric Co.
General Incandescent Arc Light Co.
Keystone Electrical Instrument Co.
Whitney Electrical Instrument Co.

Electric Soldering Irons.
American Electrical Heater Co.

Electric Launches.
Sterling & Co., C. B.

Electrical Supplies.
Bibber-White Co.
Bunnell & Co., J. H.
Central Electric Co.
Electric Appliance Co.
Jones, J., & Son.
Novelty Electric Co.
Ohio Electric Works.
Stewart, Frank H., & Co.
Western Electric Co.

Electromobiles.
American Electric Vehicle Co.

Engineers and Contractors.
McCay Engineering Co.
New England Engineering Co.
White & Co., J. G.

Engines.
American Engine Co.
Ball & Wood Co.

Fans and Fan Motors.
Central Electric Co.
Diehl Mfg. Co.
Emerson Electric Mfg. Co.
General Electric Co.
General Incandescent Arc Light Co.
Paragon Fan & Motor Co.
Warren Electric & Specialty Co.

Fiber.
Kartavert Mfg. Co.

Fixtures, Gas and Electric.
McKenney & Waterbury.

Fuse Wire and Links.
General Electric Co.
McIntire Co., The C.

Globes, Shades, Etc.
Frink, I. P.
Phœnix Glass Co.

Graphite.
Dixon Crucible Co., Jos.

House Goods.
Central Electric Co.
Ostrander & Co., W. R.

Instruments (Testing and Recording.)
Bristol Co., The
General Electric Co.
General Incandescent Arc Light Co.
Machado & Roller.
Keystone Electrical Instrument Co.
Westinghouse Electric & Mfg. Co.
Whitney Electrical Instrument Co.

Insulators and Insulating Material.
Central Electric Co.
Empire China Works.
Kartavert Mfg. Co.
Standard Paint Co.
Standard Underground Cable Co.
Sterling Supply & Mfg. Co.

Junction Boxes.
Bossert Electric Construction Co.
General Incandescent Arc Light Co.
Ward Leonard Electric Co.

Lamps, Arc.
Central Electric Co.
Diehl Mfg. Co.
General Electric Co.
General Incandescent Arc Light Co.
Standard Thermometer & Electric Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Lamps, Decorative.
Central Electric Co.
Edison Decorative & Miniature Lamp Co.
General Incandescent Arc Light Co.

Lamps, Incandescent.
American Endoscopic Co.
Buckeye Electric Co.
General Electric Co.
General Incandescent Arc Light Co.
New York & Ohio Co.
Ohio Electric Works.
Sawyer-Man Electric Co.
Shelby Electric Co.
Sperry, B. N.
Westinghouse Electric & Mfg. Co.

Lightning Arresters.
General Electric Co.
Westinghouse Electric & Mfg. Co.

Machine Tools.
Garvin Machine Co.

Mast-Arms.
Brady, T. H.
Meserve, F. W.

Meters.
Fort Wayne Electric Works.

Mica.
Munsell, Eugene.

Name-Plates.
Becker-Name Plate Co.

Paint.
Standard Paint Co.

Patent Solicitors.
Duvall, Edw. S.
Thornberry, Henry S.

Platinum.
Baker & Co.

Poles, Brackets, Pins, Etc.
Central Electric Co.
Central Mfg. Co.

Porcelain Manufacturers.
Empire China Works.

Rail Bonds.
Forest City Electric Co.
Morris Electric Co.
Roebling's Sons Co., John A.

Railway Specialties (Electric).
Central Electric Co.
Electric Appliance Company.
General Electric Co.
Novelty Electric Co.
Sterling Supply and Mfg. Co.
Western Electric Co.
Westinghouse Elec. and Mfg. Co.

Reflectors.
Frink, I. P.

Rheostats.
Cutler-Hammer Mfg. Co.
General Incandescent Arc Light Co.
Ohio Electric Specialty Mfg. Co.
Ward Leonard Electric Co.

Schools.
American School of Correspondence.
Electrical Engineer Institute of Correspondence Instruction.
International Corresp. Schools.
United Correspondence Schools.

Soldering Sticks.
Allen & Co., L. B.

Specialties.
G. & E. Electric Co.
General Incandescent Arc Light Co.
Ohio Electric Works.

Steel Spring Wire.
Boker & Co., Hermann.
Cary Spring Works
Manross, F. A.
Wallace Barnes Co.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.

Switchboards.
Bossert Electric Construction Co.
Central Electric Co.
General Electric Co.
General Incandescent Arc Light Co.
Large & Co.
Western Electric Co.

Switches, Etc.
Central Electric Co.
General Electric Co.
General Incandescent Arc Light Co.

Switches, Etc.
Hart & Hegeman Mfg. Co.
Hart Mfg. Co.
Jones & Son, J.
Paiste Co., H. T.

Telephones.
American Bell Telephone Co.
American Elec. Telephone Co.
Bunnell & Co., J. H.
Central Electric Co.
Central Telephone & Electric Co.
Connecticut Telephone & Electric Co.
Eureka Electric Co.
Gordon, A. Y.
Mianus Electric Co.
Murdock & Co., Wm. J.
National Automatic Telephone Co.
New York Telephone Co.
North Electric Co.
Ohio Electric Works.
Reliable Electric Mfg. Co.
Standard Telephone & Electric Co.
Sterling Electric Co.
Stromberg-Carlson Telegraph Mfg Co
Taber & Mayer.
Telephone Mfg. Co.
Viaduct Mfg. Co.
Western Electric Co.
Western Telephone Construction Co.
Williams-Abbott Electric Co.
Williams Electric Co.

Tools.
Garvin Machine Co.

Transformers.
Fort Wayne Electric Works.
New York & Ohio Co.
Westinghouse Electric & Mfg. Co.

Turbine Governors.
Lombard Water-Wheel Gov. Co.

Voltage Regulators.
Belknap Motor Co.

Water-Wheels.
Leffel & Co., Jas.

Wires and Cables.
American Electrical Works.
Central Electric Co.
Crefeld Electrical Works.
Eastern Electric Cable Co.
Electric Appliance Company.
General Electric Co.
India Rubber & Gutta Percha Insulating Co.
Montauk Multiphase Cable Co.
National Conduit & Cable Co.
National India Rubber Co.
New York Insulated Wire Co.
Novelty Electric Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., John A.
Safety Insulated Wire & Cable Co.
Simplex Electrical Co.
Standard Underground Cable Co.
Western Electric Co.

X-Ray Apparatus.
Ritchie & Sons.

THE "CLARK" WIRE

FOR SWITCHBOARD, RAILWAY AND MOTOR USE.

All sizes of stranded and flexible wire and cables with Clark's insulation.

Inspector Boston Fire Underwriters' Union says:—A thoroughly reliable and durable wire in every respect."

The Clark wire has been before the public, and in use, for the past 10 years, and has met with universal favor. We guarantee our insulation wherever used, Aerial, Underground, or Submarine, and our net prices are as low, if not lower than any other first-class insulated wire. We shall be pleased to mail Catalogues, with terms and discounts for quantities.

EASTERN ELECTRIC CABLE COMPANY,

HENRY A. CLARK, Treasurer and General Manager.
HERBERT H. EUSTIS, President and Electrician.
61-63 Hampshire St., BOSTON, MASS.

JUST... ISSUED.

A new catalogue of electrical books has been prepared by the ELECTRICAL REVIEW and is now ready for distribution.

Sent Free on Request...

It is the most complete and satisfactory electrical book catalogue ever prepared.

The Electrical Review
BOOK DEPARTMENT

will send **any electrical book** to **any address** in the world, postage prepaid, on receipt of catalogue price.

Any inquiries addressed to **The Electrical Review Book Department** will receive prompt attention.

Electrical Review Publishing Company,
41 Park Row,
NEW YORK.

THE BRADY MAST-ARMS.

T. H. BRADY, New Britain, Conn., U. S. A.
Manufacturer of

Mast-Arms, Pole and Swinging Hoods, Arc Cutout Boxes, Fuse Boxes, Knife Switches, Brackets, Hanger Boards, &c.

Catalogues and Prices furnished on application.

KEYSTONE ELECTRICAL INSTRUMENT CO.

PORTABLE VOLTMETERS for DIRECT and ALTERNATING-CURRENT CIRCUITS.

DIRECT READING, SENSITIVE AND ABSOLUTELY ACCURATE . . . . .

DEAD-BEAT WITHOUT THE USE OF A MECHANICAL BRAKE.

Mounted in polished mahogany case.

Reversing switch mounted on each instrument.

All ranges from 12 volts to 700 volts in single or double scales, with or without multipliers.

WRITE FOR PRICES.

We manufacture a full line of Switchboard Instruments for Central Stations and Isolated Plants.

Catalogues and Prices on application.

Ninth St. and Montgomery Ave., Philadelphia.
NEW YORK, 15 Cortlandt St. CHICAGO, 231 S. Canal Street.
BOSTON 170 Summer Street.

WATER WHEELS

For Heads of 3 Feet to 2000 Feet.
Especially adapted to all kinds of
ELECTRIC POWER AND LIGHTING PLANTS.

Recent tests at Holyoke, given below, enable us to guarantee: *The Largest Power ever obtained from a wheel of the same diameter. The highest speed ever obtained for the same power. The highest mean efficiency when running from half to full gate.* We guarantee also: *A runner of the greatest possible strength. A gate unequaled in quickness and ease of opening and closing.*

Test of a 45 in. SAMSON, Jan. 25, 97.

Gate Open.	Head.	Rev. Pr. Min.	Cu. Ft. Pr. Sec.	Horse Power.	Per Cent.
Full	15.00	144.00	172.69	240.97	82.03
7/8	15.04	138.12	155 03	223.61	84 55
3/4	15.11	127.67	133.24	191.06	83.68
5/8	15.88	131.50	112.65	162.80	80 25
1/2	16.47	126.87	90.04	127.73	75.95

Test of a 35 inch SAMSON, Feb.1,'97.

Gate Open.	Head.	Rev. Pr. Min.	Cu. Ft. Pr. Sec.	Horse Power.	Per Cent.
Full	15.29	194 25	102.02	143.44	81.08
7/8	16.56	187.75	92.13	146.73	84 78
3/4	17.33	178.50	83.95	138.40	83.85
5/8	17.54	176.40	68.82	109.64	80.09
1/2	17.68	168.50	57.69	88.14	76.19

JAMES LEFFEL & CO., Springfield, Ohio, U. S. A.

CAN WATER-WHEELS BE GOVERNED?

If you will give us a description of your water-wheels and how they are set, we can refer you to a plant similarly arranged, where our governors are in use. Our governors are now being used to regulate over

SEVENTY-FIVE THOUSAND HORSE-POWER

of water-wheels in this country alone. We sell our governors with a POSITIVE GUARANTEE that they will give a better speed regulation than any other make of governor.

LOMBARD WATER-WHEEL GOVERNOR CO.,
61 Hampshire Street (Roxbury District), BOSTON, MASS.

PLATINUM

IN SHEET OR WIRE, ANY SIZE, SHAPE OR DEGREE OF HARDNESS, FOR ALL PURPOSES.

BAKER & CO.,

408-410-412-414 N. J. RAILROAD AVE., NEWARK, N. J.
NEW YORK OFFICE, 120 LIBERTY STREET.
Scrap and Native Platinum Purchased.

THE COLUMBIA DRY CELL...

Is the BEST on earth.

Five Different Sizes.

PARTICULARS, PRICES, AND OUR 70-PAGE CATALOGUE FOR THE ASKING.

National Carbon Co.,

965 Highland Avenue, Cleveland, Ohio.

THE STANDARD P AND B

ELECTRICAL COMPOUNDS.
ARMATURE AND FIELD-COIL VARNISH.
INSULATING TAPE.
RUBEROID MOTOR CLOTH.

MANUFACTURED BY

The Standard Paint Company,

Chicago Office, 189 Fifth Avenue. 81-83 JOHN STREET, N. Y. Write for Particulars.

NOVELTY ELECTRIC CO.,

PHILADELPHIA, PA.

Agents for
- Okonite Insulated Wires.
- Medbury Overhead Railway Material.
- Changeable Electric Headlights.
- Globe Metal Works' Trolley Wheels.
- P & B Electrical Compounds.
- Perkins Incandescent Lamps.
- Schiff, Jordan & Co.'s Ship Cored Carbons.

ELECTRICAL SUPPLIES OF EVERY KIND.

If "THE BEST" is your hobby, use

THE ALLEN SOLDERING STICK
Non-Corrosive, Convenient and Effective
A SUBSTITUTE FOR RESIN, ACIDS, AND SOLDERING SALTS.
FOR ALL ELECTRIC WORK.

MANUFACTURED EXCLUSIVELY BY

L. B. ALLEN CO.,

1335 COLUMBIA AVENUE, CHICAGO, ILL., U. S. A.

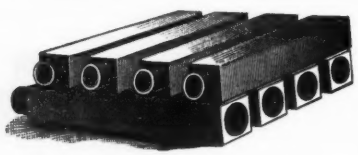
DIXON'S GRAPHITED WOOD GREASE

FOR TROLLEY CAR GEARS.

ABSOLUTELY PREVENTS NOISE AND DOES NOT OOZE OUT OF GEAR CASE.

"LASTS THREE TIMES AS LONG AS ANY OTHER LUBRICANT."

JOS. DIXON CRUCIBLE CO., JERSEY CITY, N. J.



THE WYCKOFF CREOSOTING CO.,
WILLIAMSPORT, PA.
MANUFACTURERS OF
WYCKOFF WOODEN CONDUITS
Also Poles and Cross-Arms.

KARTAVERT

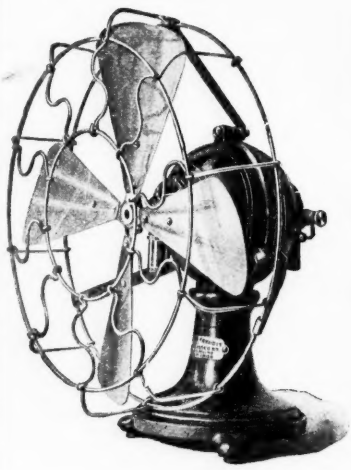
FIBER! FIBER! FIBER!

HARD AND FLEXIBLE. IN SHEETS, RODS AND TUBING.

For ELECTRICAL and Mechanical purposes, Railway dust guards, Washers and packings.

MANUFACTURED BY

THE KARTAVERT MANUFACTURING CO., Wilmington, Del.
P. O. BOX 625.



FAN MOTORS.

Write for Prices of Fan Motors.

All Copper Knife Switches, Etc., Etc.
General Electrical Supplies.

SUPPLY DEPARTMENT:

SCHIFF, JORDAN & CO.,
232 Greenwich St., New York.